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ADVANCED MANAGEMENT

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SOCIETY FOR ADVANCEMENT OF MANAGEMENT
The Pioneer in Management Philosophy

UNIVERSITY OF PENNSYLVANIA—THE 1954 WHARTON CONFERENCE

WORK SIMPLIFICATION AND MEASUREMENT IN THE OFFICE AND FACTORY

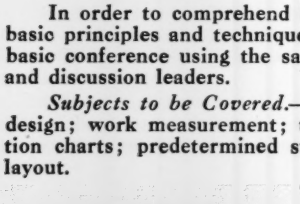
JUNE 21 TO JULY 2, 1954 IN THE New Air Conditioned TAYLOR MANAGEMENT LABORATORY

CONFERENCE TOPICS: 1. SIMPLIFYING PRACTICES: A focus upon the latest available techniques to accomplish work simplification and to eliminate waste. Discussion of the function of methods and systems work—its tasks, its needs, its problems. 2. DEVELOPING WORK MEASUREMENTS: Discussion of selected current techniques such as predetermined standards, standard data. An evaluation of the newest developments in the effort rating field. 3. OBTAINING EMPLOYEE ACCEPTANCE: A focus upon the human element and the problems of worker motivation. An evaluation of industrial engineering and systems work — the scientific method, contractual obligations, "selling the installation."

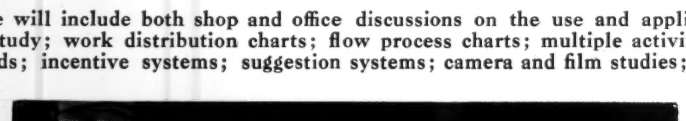
SPECIAL ONE-WEEK PRE-CONFERENCE SESSION ON BASIC TOOLS AND TECHNIQUES, JUNE 14 TO JUNE 18, 1954

In order to comprehend better the higher-level work of the regular two-week conference, certain conferees may wish to review the basic principles and techniques in the one-week optional session offered prior to the regular conference. It will be a highly concentrated basic conference using the same schedule pattern as the regular conference with the faculty of the Wharton School serving as lecturers and discussion leaders.

Subjects to be Covered.—These will include both shop and office discussions on the use and application of: motion economy; forms design; work measurement; time study; work distribution charts; flow process charts; multiple activity charts; workplace charts; operation charts; predetermined standards; incentive systems; suggestion systems; camera and film studies; materials handling; office and plant layout.



RALPH M. BARNES



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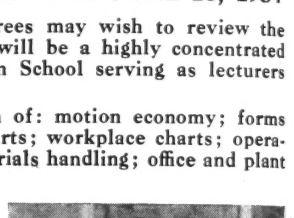

MARVIN E. MUNDEL

1954 CONFERENCE SPEAKERS ON SELECTED SUBJECTS

Lillian M. Gilbreth: "A Critical Analysis of World-wide Industrial Engineering Progress, Future Prospects and the Human Factors Involved." *Ralph M. Barnes:* University of California, "The Changing Concept of Industrial Engineering." *Phil Carroll:* Consultant, "How to Control Production Costs Through Proper Work Measurement." *Marvin E. Mundel:* Marquette University, "Training Aids for the Industrial Engineer & Office Systems Man." *Ben S. Graham:* The Standard Register Co., "Work Simplification, A Tool in Human Relations." *Don H. Johnson:* Manufacturing Staff, General Motors Corp., "Approaching Methods Work through Participation and Training." *Fred Smith:* Gruen Watch Co., "Personality Complexes in Work Simplification Programs." *Philip B. Hoffman:* Johnson & Johnson Co., "Management's Stake in Industrial Engineering and Office Procedures Work." *Harold Engstrom:* Sonotone Corporation, "The Value of Predetermined Time Systems." *Vincent Flynn:* SAM, "Establishing Normal Productivity through the SAM Rating Films." *Robert P. Brecht:* Wharton School, "The 'Logic of Efficiency' and Its Acceptability in Practice." *Jerome Barnum:* Jerome Barnum Associates, "The Humanics of Industrial Engineering." *Elles Derby:* Metropolitan Life Insurance Co., "Defining, Selecting and Training Systems Men." *John B. Joynt:* American Enka Corp., "Designing and Building a Systems Department." *George W. Taylor:* Wharton School, "The Acceptance of Technological Change by Workers and Unions." *James Duncan:* The Work Factor Company, "Predetermined Time Values for Setting Standards." *Wright Manvel:* General Electric Company, "A Critical Evaluation of Predetermined Time Value Systems." *Dawson Dean:* American Home Products Corp., "Testing and Selection Techniques to Aid Industrial Engineering." *Richard Neumaier:* Office Systems Consultant, "Mechanization in the Office." *Nicholas A. Martucci:* N.I.C.B., "Practical Application of Simplification Techniques in Both Shop and Office." *Paul B. Mulligan:* Paul B. Mulligan Co., "Predetermined Time Values in the Office." *Solomon Barkin:* Textile Workers of America, "The Union Attitude Towards Technological Change." *Erman A. Gentile:* Strick Trailer Co., "Problems of Starting An Office Work Simplification Program." *Robert E. Heiland:* Lehigh University, "The Ratio Delay Study for Setting Standards." *Rexford Hersey:* Wharton School, "Does the Industrial Engineer and Office Systems Man Need to be a Psychologist?" *David A. Ginsburg:* The Wheeldex Co., "The 'How To Do It' of Office and Shop Systems Work." *Thomas Pitney:* Sylvania Electric Co., "Practical Standards for Clerical Activity." *Adam Abruzzi:* Stevens Institute, "Setting Production Standards by Statistical Methods." *H. C. Geppinger:* General Electric Co., "Dimensional Motion Time Standards."

REGISTRATION: Advance registration is required. Applications of qualified conferees will be accepted in the order received.

Although no University credit will be given to conferees, a certificate of achievement will be awarded upon satisfactory completion of the conference.

Since the optional first week concentrates on basic techniques, registration will be strictly limited to 30 conferees. The regular 2 weeks' conference will be limited to 60 conferees. LIVING ACCOMMODATIONS will be arranged for those requiring them, in fraternity houses at cost. Phi Delta Theta and Kappa Sigma houses have done an outstanding job of making the conferees comfortable.

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Name ..... Firm .....

Address ..... Position .....

Remittance enclosed—for full conference $500.00 ☐ For 2 weeks regular conference $350.00 ☐

Address: V. Donald Schoeller, Conference Director, W160 Dietrich Hall, Wharton School, University of Pennsylvania, Philadelphia 4, Pa.

(Checks to be made to order of the Trustees of the University of Pennsylvania.)

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Trying To Grow in a Vacuum . . . ?

CREATIVE stimulation is the result of association and work with others. We move ahead when we trade ideas, philosophies and concepts. Development and growth cannot occur in a vacuum.

Under pressure of daily operations, management men seldom have the opportunity to leave their offices to benefit from contact with outstanding industrial men; the kind of men who will attend the Ninth Annual Industrial Engineering Conference sponsored by SAM, April 29-30, in New York. Over 2,000 business leaders set aside these two days each year to experience the stimulation and growth which are a requirement for alert management men.

The Conference will present the latest creative developments in time study and methods, and is of importance to anyone responsible for competitive costs —general managers, controllers, industrial engineers and supervisors. This Conference gives ideas an airing, promoting growth. Growth becomes tangible in lowered costs.

Once methods improvement and work measurement were regarded as separate areas, performed by different departments of management. Today we realize the basic unity in such functions. They are combined into an integrated operation. In such ways as this, it is possible for enlightened management greatly to simplify industrial operations and to reduce the waste-component of costs, while at the same time contributing to increasing productivity.

At the April 29-30 SAM Creative Time Study and Methods Conference, through information presented by top-management speakers, and through the stimulation of personal contact with the kind of men who may have solved your problem in their own industry, you should be able to chart the way to cost reductions amounting to ten per cent or more.

Not in a vacuum, but in such free interchange of creative ideas, does modern management grow and develop.

BRUCE PAYNE, PRESIDENT, SAM

Another Pioneering Conference

On January 28th and 29th the Society for Advancement of Management held an Operations Research conference at the Park Sheraton Hotel, New York City. Key personnel from industrial organizations and universities in the United States and Canada attended.

This conference, conceived in the SAM National Office and approved by the Society's Executive Committee, was completely produced by the National Office staff. Expenses were carefully controlled and the conference was financially successful as well as outstanding in the quality of its content and the caliber of its speakers. Invitations had been sent only to SAM members and a select group of others who have consistently supported SAM activities.

One of the interesting outgrowths of this conference was the strong interest expressed in a SAM-sponsored summer seminar on Operations Research. In addition, most of those present indicated that they look forward to a similar conference under SAM auspices next year. We hope to be able to meet these expectations.

In a very real sense, this conference may be regarded as a milestone in the history of SAM and the development of modern management. From the historical viewpoint, it marks the first time that our Society has effected a full-fledged meeting between the vanguard talent of Operations Research and a representative corps of management leaders whose organizations play so vital a role in present-day economy. From the viewpoint of management development, the conference succeeded splendidly in establishing a concrete basis of mutual understanding and appreciation between the intricacies of Operations Research and the complex dynamics of modern management. This channelization was an achievement of major proportions, probably the groundwork of a *modus* of communications which will, in due time, facilitate management's accessibility to the almost incredible advantages of Operations Research. Both during and between sessions—and during meals and social periods—a genuine intermeshing of ideas and problems took place, a wholesome give-and-take calculated to sharpen the perspective of all concerned. At the end of the final session, one conferee aptly remarked, "Management now knows tremendously more about Operations Research; and Operations Research has some new insights into management's problems."

The speakers and panelists stressed the practical applications of Operations Research, covering pure theory only where unavoidable. Case histories illustrated every application, thereby giving flesh and blood to such topics as Symbolic Logic, Decision Theory and Information Handling. Among the management areas discussed were Production, Finance, Management Research, Marketing, Inventory, and the Construction and Administration of an Operations Research Program.

Limited hotel facilities necessitated limited advanced registration for this conference; however, the Proceedings are being prepared and will be available, in whole and in part, at cost of production. Prices will be announced soon.

Our Society can take rightful pride in this latest fulfillment of one of its prime purposes: "Through research, discussion, publication and other appropriate means, to conduct and promote scientific study of the principles governing organized effort in industrial and economic life, including both labor and management, and to impart to the public information concerning said principles and their various applications for general betterment of society, particularly by, but not limited to, elimination of unnecessary effort and unduly burdensome toil."

C. A. Slocum, Executive Director, SAM

How Industry Is Using The S.A.M. Performance Rating Films

A RECENTLY completed survey of industrial organizations using S.A.M. Performance Rating Films discloses that

1. These films are reducing considerably the cost of training time study personnel.
2. The films are substantially improving work measurement techniques throughout industry at large by increasing the skill and consistency of performance rating judgment in both experienced and new time study personnel.
3. The films provide an excellent frame of reference in expediting grievances over specific interpretations of the concept, "a fair day's work."

Since their issuance in October, 1950, the S.A.M. Performance Rating Films have been used by leading industrial organizations throughout North and South America and most of the free countries of Europe. Although occasional reports had been received from individual companies, detailing the increased efficiency of their time study men who had been trained through use of these films, there remained to be made a survey which would form a basis of experience evaluation. In September, 1953, the S.A.M. National Research Committee, under chairmanship of Ralph C. Davis, National S.A.M. Vice President of Management Research and Development, authorized a survey to determine the specific needs that the films have answered among the industrial organizations using them. The project went to Dr. Vincent A. Flynn, the Society's Research Director.

A questionnaire was mailed to the first 155 companies that had purchased one or more sets of the films. Answers were received from 102 companies representing 22 States in the U. S. A. and 5 cities in Canada. A fair degree of cross-sectionality is reflected in the types of industry replying: heavy and light machinery; chemicals; food; paper pulp; textiles; advertising; transportation; furniture; electronics; foundry; mail order; engineering instruments; packaging; light assembly; consulting. The average length of film ownership in the replies was 23 months.

Following is a composite tally of company responses respecting specific uses which the films have served:

TRAINING: Of the 102 companies reporting, 90 use the films for training new time study men; 99 as part of a refresher program with experienced personnel. A total of 6610 time study men used the films as part of rating training in the survey period.

Forty-seven companies ventured an estimate, percentagewise, of time saved through use of these films in training new time study personnel to a point of acceptable proficiency in performance rating. Estimates ran from (2%) to (80%) with an arithmetic mean of (26%). The remaining companies had not made a study on which to report an estimate; however, 27 of these felt that a reduction in training time had resulted.

It is interesting to note that if the above time-saving mean (26%) were applied to the surveyed average of training time (15.5 weeks)* the saving would be approximately 4 weeks or 160 man-hours per trainee.

SELECTION OF TIME STUDY PERSONNEL: A total of 15 companies use the S.A.M. Films to aid in the selection of trainable applicants for time study positions.

BASIS OF RELATED TRAINING PROGRAMS: The S.A.M. Films were used by 35 companies in planning and making their own films for time study training, work simplification, methods study and job training.

SETTING, CHECKING PRODUCTION STANDARDS: The films are used by 12 companies in setting their own standard data. An additional 5 companies derive predetermined times from the films; 22 companies use the films to check production standards.

GENERAL ORIENTATION TO TIME STUDY: For purposes of general information on time study philosophy and technique, the films were shown and explained to top-management personnel by 35 companies; to foremen and production supervisors by 75 companies; to union officials by 21 companies. A total of 6801 management personnel (excluding time study men) were shown the films in 87 companies; 2004 non-management personnel in 44 companies.

GRIEVANCES OVER STANDARDS: Of the 9 companies reporting use of the S.A.M. Performance Rating Films to settle grievances over time study production standards, all 9 found the films instrumental in reducing the incidence of such grievances, and 7 of the companies found the films useful in reducing the handling time of individual grievances. It is interesting to note, in this connection, that the S.A.M. Films have been used in arbitrational settlement.

ADDENDA: All but a few of the responding companies requested data on the variations in task allowances, as well as attainment expectancy of the average operator on incentive, that were encountered in research when these films were originally rated by more than 1200 experienced time study men from 181 companies throughout the United States. These data, along with other interesting facts derived from research on the S.A.M. Films, will be presented in a volume soon to be published by the Society.

A large number of responding companies indicated additional uses served by the films; for example: Many felt that the S.A.M. Performance Rating Films increased self-confidence as well as skill in both old and new time study personnel. Several companies were particularly pleased with the improvement in rating consistency gained from use of the films. One multiplant company noted that the S.A.M. Films are rapidly succeeding in unifying diverse systems of time study throughout the organization. Several companies stressed the role these films have played in heightening the union's confidence in time study administration.

The over-all responses from the sample surveyed indicate that the S.A.M. Performance Rating Films are serving well their original objectives:

(a) to establish bench marks of proper performance on operations representing a broad range of manufacturing and clerical work;

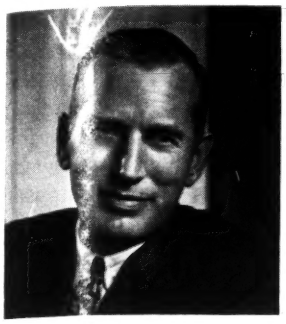
(b) to provide a concrete basis for judging industry differences in the concept of proper performance;

(c) to provide a valid training procedure in time study, and a follow-up measure for consistency;

(d) to help resolve grievances quickly and accurately;

(e) to provide a source of standard data.

*The average is derived from a recent (unpublished) S.A.M. research in which the time study policies and practices of 181 companies (202 plants) throughout the United States and Canada are reported.



CRAWFORD H. GREENEWALT has been president, chairman of the Executive Committee, and a member of the Finance Committee of du Pont since January 19, 1948. He began his career in 1922 when he joined the compar, as a chemist. Mr. Greenewalt is the tenth president of du Pont, the second not of the family name in 150 years. Prior to his present position, he had been stationed in four manufacturing and two auxiliary departments, and had been vice-President and Director of the company. During World War II he played an important role in the program which culminated in the Hanford plutonium plant, and was also active in the development of nylon.

The Big Question: Business — Good or Bad?

by Crawford H. Greenewalt, President
E. I. du Pont de Nemours & Company

No economy rides along in a straight line; absolute stability and industrial progress are incompatible. But if business and industry keep their eyes on the long-term upward trend, the future cannot be bad. Inventories, government spending, business indicators do not shape the economic orbit. Human courage, desires, inventiveness, and incentive do. And they show no signs of abating; rather they flourish in the atmosphere provided by modern American management. Here is an article that provides a close, sharp answer to the question that harries all American business today.

No question is being asked more frequently these days than, "How good or bad is business going to be this year?" Will it be up or will it be down? If it is down, will we be in a recession, or merely a readjustment? As an American businessman, the question causes me deep embarrassment. If I tell the truth and say I don't know, people think I am an ignorant fellow. If I close my eyes and say up five per cent or down ten per cent, according to my mood at the time, I am violating a cardinal principle of my scientific training which is to be both objective and honest.

I admire the courage of the economist who retires into his kitchen and compounds a witch's brew of such items as personal income, inventories, construction, farm prices, government spending, and the money supply, and comes out with the statement that the production index in the third quarter of 1954 is going to be 127, no more, no less. Maybe he will be right, but the odds are much better that he will be wrong.

We have also the rather grim technique of those who have said, in every year since World War II, that the next year will see business falling off. Perhaps we should admire their persistence, but it is only fair to point out that, like the man who calls heads every time a coin is flipped, sooner or later they will be right. They may even be right in 1954.

Of one thing we can be sure. That is, that our economy does not ride along in a straight line. Like any countryside it has its hills and dales, its ups and downs. It would be far more constructive if, instead of trying to predict the precise shape of the hill or valley in the year ahead, business people would find ways to minimize these inevitable ups and downs so as to remove from the horizon both the high peaks of 1929 or the deep canyons of the early '30s.

Stability in the business cycle and industrial progress are completely incompatible. Stability by definition means leveling out, or to use a less pleasant word, stagnation. I doubt that there is any thoughtful businessman who would trade progress for stability, either for himself or for the American economy.

We have in this country not an economy of necessity, but an economy of abundance. Our consumption of food, shelter, and clothing (all necessities of life) is predictable within reasonably narrow limits. Our consumption of automobiles, television sets, washing machines, the other luxuries of an abundant life, is in large measure unpredictable. For that depends not upon our desires, which are insatiable and endless. It depends simply on the average outlook of people, whether they feel safe in increasing their consumption, or whether they are fearful of their economic well-being.

A few centuries ago, people had few luxuries. Their preoccupation was mainly with keeping themselves fed, clothed, and sheltered. In those days, depressions were influenced more by the weather and its effect on agriculture than by any other single factor. Even in this area forecasters were notoriously inaccurate, as they are today. Weather still seems frequently unpredictable.

In modern times, however, causes of recession are much more nebulous. They depend not upon natural phenomena but upon human decision. Whether or not we will have a recession in 1954 will depend largely upon the direction of the

national psychology, and on decisions that are influenced less by rational economic reasoning than by simple confidence and optimism. Obviously this involves great numbers of people, and the governing decisions will be made not only in business offices and board rooms but around the dining-room table in millions of American homes. What we call "buying power" is in this country no arbitrary factor. For most of the things people buy are deferable. The purchase of that new automobile can be put off until next year. The current television set or washing machine or refrigerator can be tolerated a while longer. The new house doesn't have to be built. If people in the mass as consumers and as businessmen feel that they wish to defer a large percentage of their normal purchases, we will surely have a recession. If they are confident, willing, and able to satisfy their desires, we will have a boom. In short, if we could find some way of climbing into the minds of 160 million people, we could tell very easily how good or bad business is going to be.

No one has yet learned how to measure or how to influence people's confidence. A few things we do know. We know, for example, that a depression, once started, accumulates momentum like a snowball rolling down a hill, and that panic is a communicable disease far worse and far more rapid in its spread than any that affect us physically. It follows then that the business community must accept major responsibility for seeing that panic does not start. It can do so by maintaining its confidence high, and its economic temperature as near normal as possible. In this atmosphere, the corrections that will be applied will be small and not in themselves frightening.

Corrections Should be Made Over Long Period of Time

Today business inventories are said to be high, perhaps substantially higher than can be justified by present or expected sales volume. If business people should suddenly decide to correct that situation all at once, panic and depression would almost surely ensue. If, on the other hand, the correction is made in small increments over a reasonable period of time, the problem should be manageable, and confidence maintained.

But above all else, industry must keep its eye firmly fixed upon the long-term upward trend—the amazing and dynamic industrial progress shown in this country over many years. For in the last analysis it is that upward thrust in inventiveness and productivity that is the sure and tested tool that puts an end to any depression whether it is major or minor.

American Business has Survived Many Depressions

Let me cite an example. The first available Du Pont balance sheet is for the year 1810. In that year the assets totaled $109,000. A hundred years later, in 1910, they were $81 million. Today, excluding investment in the General Motors Corporation, they are approximately $2 billion. If these figures are translated into growth rates, we find that both in the first 100 years and the last 50 that rate of growth has been about seven per cent per year compounded. The point of this history is to emphasize that in that 150-year period, America had five major wars, at least six depressions of very substantial magnitude, and all conceivable shades of political climate and opinion, and American business and industry is still here and still growing.

It would be interesting if the presidents of the Du Pont Company had kept personal diaries. Unfortunately they did not, but I am perfectly sure that each of my predecessors at some time in his presidency worried and fretted for fear the business might collapse or suffer some major and permanent setback. The founder, the first E. I. du Pont, had to borrow money in the severe depression of 1819 to rebuild his factory that was destroyed by explosion. General Henry du Pont, his son, passed successfully through the Civil War and the two depressions that followed it. I have heard Irenee du Pont talk about sleepless nights during the depression of 1921 and Lammot du Pont speak of the trials and tribulations of 1932. I confess to some troubles and worries of my own.

The point is that when those events are viewed against the pattern of our country's steady long-term growth and prosperity, the bad times, so troublesome in their particular setting, fade first into unpleasant memories and finally to unimportant historical items in dusty and forgotten archives.

It is significant to note that when anyone in the past has attempted to predict the long-term future, his forecast has turned out to be hopelessly shortsighted and pessimistic. Benjamin Franklin thought, at the end of his life, that it would take centuries to settle the American continent. The State of California stands as a monument to his error. Thomas Jefferson, in announcing the Louisiana Purchase, felt that the territory might be fully occupied after 25 generations. The railroad and the steamboat opened it up to settlement within a few decades. In the early 1900's a gentleman from Philadelphia grew enthusiastic about private motorcars and foresaw the time when there would be a hundred or so in every city. I might add that he viewed this development as a boon to highway safety as it would free the country from drunken riders and wild horses. A British socialist during the 19th century foresaw the period when it would be unnecessary for children to work more than 10 hours a day.

The economist Jevons, in 1860, was alarmed at the possible exhaustion of the earth's coal supply within a few years. I have heard similar predictions on petroleum almost yearly since my college days. Sir William Crookes, a distinguished scientist, saw early starvation of the race through diminishing supplies of nitrogen. What he did not foresee was that chemistry through nitrogen fixation would within a generation or so prove his error.

Economy is Shaped by Human Courage, Inventiveness

It should be evident that the progress of genius and inventiveness is something that is always underrated. I think that those who become unduly alarmed at our short-term prospects are guilty of economic myopia. They forget that our economic orbit is shaped not by inventories, government spending, or any of the host of business indicators, but by human courage, desires, and incentive.

There has been much speculation as to the reasons for this spectular advance of our American economy. Some have ascribed it to the size of our continent, some to our raw material resources, some to the strength and vigor of our people. To me the answer is a simple one. It is nothing more than human ingenuity operating in an atmosphere of individual freedom and incentive.

Genius and inventiveness are found among the people of every nation. They are not an American monopoly. But the atmosphere of freedom in which Americans live and work is unique among nations. It is in itself a creation of man's genius, an experiment born of dissatisfaction with the authority of the state, the guilds, a rigid social order, and all of the confining trappings of 18th century Europe. Our experiment in government has succeeded beyond the fondest expec-

tations of its founders. Not even they could foresee the effects of man's daring, vision, and creativeness set free to operate without let or hindrance.

The direction of our effort has changed over these two centuries of our national existence. Our first hundred years were the years of the pioneer, the explorer, setting out from the comfort of the East to conquer and settle the unknown West, to bring our continent under the plow and to create an agricultural abundance for our growing population.

A New Frontier in the Research Laboratory

In recent times we have become an industrial, not an agricultural, nation. It is to our factories and our industries we look for the ever more abundant life each one of us seeks.

The 20th century pioneer has turned from land and mine to the much more challenging exploration of the physical sciences. Our frontiers have moved from the West into the research laboratory and in that move have become frontiers without limit.

Today it is research that gives the American economy its characteristic surge and its dynamic qualities. And research requires people with the same courage, vision, and determination as those who a century ago crossed the western plains.

In the pioneering of the laboratory we encounter the same risks, the same disappointments, the same frustrations. Research today requires large organizations of technical specialists and elaborate facilities. It requires time, for the interval between the start of a research project and its successful conclusion becomes longer as scientific techniques grow more complex. And it requires enough financial confidence and patience to allow for the long succession of failures that accompany commercial success.

There is no essential difference between the explorers and homesteaders of the past and the scientific pioneers of the present. Both require faith in their objective, confidence in the future, and the knowledge that the rewards of success are there to be reaped and kept if success attends their efforts.

The results achieved in our laboratories and factories have indeed been staggering. We have only to go back to our youth to see what enormous benefits science has brought in one generation.

In the past 25 years the Du Pont Company alone has spent approximately $475 million on research, excluding the cost of the buildings and equipment with which our research is done. Over the same period of years expenditures for new plants and equipment have been approximately $1,400 million. In other words, a single company has spent about three dollars in productive facilities for every dollar spent in the research laboratory. And this ratio of three to one has been relatively constant over an even longer period, during which our annual research bill has grown from $1 million to $50 million. During this same 25 years the company's employment has increased from 38,000 to 90,000. That growth in employment is the net of the jobs created through the introduction of new products, less those lost through increased productivity. Obviously the leverage of research in making new employment opportunities is enormous.

This is by no means the end. Many more employment opportunities come about elsewhere as a result of a firm's research activities. A new material, such as nylon or cellophane, becomes the basis for increased business activity on the part of those who fabricate and sell the finished products arising out of the new basic materials which only a large business can supply. Others find new employment possibilities in the manufacture of machinery, tools and equipment necessary to new uses. How large a circle this becomes would vary, and its radius is hard to compute. But as an example, Du Pont has estimated that for every one of 5,000 employees making cellophane, there are two workers engaged in its conversion and distribution. These jobs were created as a direct consequence of the development of cellophane.

Are We Reaching An Industrial Plateau?

I cite the Du Pont Company's figures merely by way of example. While Du Pont's present $50 million annual research bill is large in the absolute, it is a very small fraction indeed of the industrial research that is being done in the whole country's industries.

There has been some talk in past years of the possibility that our economy is maturing, that we are reaching an industrial plateau from which we will progress only as our population increases. That point of view seems to me to be nonsense. It is tantamount to saying that the last scientific barrier has been crossed, that there is no fruitful objective for further research, that man's appetite for a more abundant life has been fulfilled.

On the contrary, in the 50 years or so during which we have practiced applied science, it seems to me we have made only the smallest of forward strides. The horizons before us are unlimited and extend far beyond our present vision.

I cannot and would not try to predict the precise shape of things to come. Were I to do so, future events would show simply that I had been shortsighted. But I am very sure that great progress will be made, that the shape of industry 150 years from now would surprise me just as much as the founder of the Du Pont Company would be astonished at the heights to which his little business has grown.

It is essential that as American business and industry makes its way through the squalls and alarms of 1954, that we keep our eye on the main goal, which is the continuation of progress to greater productivity, to greater abundance, to new products for the betterment and simplification of our lives.

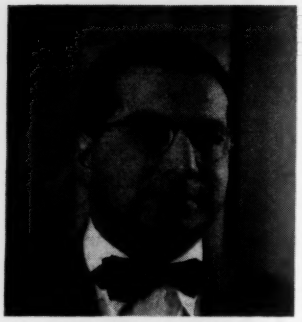
I do not think this requires us to forsake the search for what we call security. It does require us to know precisely what we mean when we define security as our goal.

Long-Range View Sustained Early Pioneers

In the early days of the last century, there was a kind of security in the well-established settlements of our Eastern seacoast. The pioneers who journeyed westward across harsh and inhospitable country were not unmindful of the blessings and comforts they had left behind. But they perceived that, in the long view, a greater security was to be found in the enterprise that led them west. Today, in accepting the risks and hazards implicit in industrial progress, we reach for the only real security—the abundance that enterprise will bring.

We must not accept a definition of security that merely preserves the status quo. That attitude will lead to stagnation and something like the dark ages of medieval history—a depression that lasted more than 800 years.

If we are to avoid it, we must most of all keep alive that spirit of confidence and optimistic venture that has been so fruitful in the past. We must remember that America was built by people who wore rose-colored glasses. For them and for us the air is clear, the sunshine is bright, and the horizons present exciting vistas. **END**



A. D. JOSEPH EMERZIAN is Assistant Professor of Industrial Administration at the University of Connecticut's School of Business, as well as Director and Research Chairman of the Hartford SAM Chapter. His former positions include Time Study and Methods engineer for the Connecticut Telephone & Electric Co. and for the New Departure Co. Mr. Emerzian has contributed a number of articles to Connecticut Industry in his line of work, and is the author of an article appearing in a recent Management Review. His name is listed in Who's Who in American Universities and Colleges, Who's Who in Education, and the Directory of American Scholars.

Graphical Analysis In Objective Ratings

by A. D. Joseph Emerzian
Assistant Professor of Industrial Administration, University of Connecticut

The technique of rating gives rise to problems which require special understanding. New aids such as objective rating films can be made more effective by the development of an appropriate checking means. A recognized authority with professional as well as academic experience discusses the employment of objective rating films, and offers here a knowledgeable survey of the reasons and uses of such objective analyses in this highly technical field.

MANAGEMENT'S interest in objective rating films has been growing since the Society for Advancement of Management rating films were first made available for distribution. These films, as well as those produced by leading universities and progressive companies, are part of a general program to assist time study men better to understand the rating phenomenon. A greater understanding of the idiosyncrasies of rating will contribute toward greater control over the rating process, and greater control will manifest itself in more accurate and reliable time standards.

The purpose of this paper is to develop further the implications which arise from current uses of objective rating films, and to suggest additional areas for their employment.[1]

Rating is a technique for equating differences in operator performance. These differences exist between individuals as well as within the same individual performing the same activity at different time periods. The purpose of rating is to determine the normal time[2] for activities notwithstanding differences in performance between and within individuals. Rating is, therefore, a process which consists of two steps: (1) determination of the rating and (2) calculation of the normal time.[3]

The rating is determined by judgment and is quantified through the use of numerical rating scales. Under pace rating, this judgment consists of a mental comparison between a mental concept of normal pace and the observed pace. It can be explained by saying it is an estimate of the difference between the standard pace and the actual pace. With a 100 per cent rating base, 100 per cent is considered the normal pace or standard. To arrive at a rating, the time study observer goes through the following mental process. First, he makes a gross judgment which places the observed performance either above or below normal (standard). His second judgment indicates the precise position along the rating scale which properly evaluates the numerical difference between standard and actual performance. The second and final judgment estimates by how much the observed performance differs from normal performance.

Once the rating has been made, calculation of normal time is a matter of moment. The basic formula is:

$$T_{NR} = R\ (T_A)$$

Where: 1. T_{NR} = estimated normal time
2. R = rating coefficient[4]
3. T_A = actual time

It has already been stated that the purpose of rating is to determine accurate

1 The author is indebted to his colleague, Professor Zenon Malinowski, for many useful suggestions and comments.

2 Society for Advancement of Management, *Glossary of Terms*, p. 17.

3 We will assume that time, adjusted for job difficulty and other allowances, properly measures work content. For a discussion of the nature of quantity rated see H. E. Smalley, "New Horizons in Time Study," *Modern Management*, April and May, 1949; M. E. Mundel, *Motion and Time Study*, Prentice-Hall, Inc., N. Y., 1950; and L. A. Sylvester, *Advanced Time-Motion Study*, Funk and Wagnalls Co., New York, 1950.

4 The rating coefficient is the assigned rating in percent divided by the rating base. Under the 100 percent rating base plan, it would be $\frac{\text{Rating}}{100}$.

Table 1
COEFFICIENTS OF RATING ERROR EFFECT

Rating Level (1)	Actual Time (T_A) in Minutes (2)	Normal Time (T_{NR}) in Minutes (3)	Absolute Rating Error (E_A) in Minutes (4)	Per Cent Rating Error (E_P) (5)	Coefficients of Rating Error Effect (6)
40	.3250	.1463	.0163	12.50[1]	2.50
45	.2889	.1444	.0144	11.10	2.22
50	.2600	.1430	.0143	10.00	2.00
55	.2364	.1412	.0142	9.09	1.82
60	.2167	.1408	.0108	8.33	1.67
65	.2000	.1400	.0100	7.69	1.54
70	.1857	.1393	.0093	7.14	1.43
75	.1733	.1387	.0087	6.67	1.33
80	.1625	.1381	.0081	6.25	1.25
85	.1529	.1376	.0076	5.88	1.18
90	.1444	.1372	.0072	5.56	1.11
95	.1368	.1368	.0068	5.26	1.05
100	.1300	.1365	.0065	5.00	1.00
105	.1238	.1362	.0062	4.76	.95
110	.1182	.1359	.0059	4.55	.91
115	.1130	.1357	.0057	4.35	.87
120	.1083	.1354	.0054	4.17	.83
125	.1040	.1352	.0052	4.00	.80
130	.1000	.1350	.0050	3.85	.77
135	.0963	.1348	.0048	3.70	.74
140	.0929	.1346	.0046	3.57	.71
145	.0897	.1345	.0045	3.45	.69
150	.0867	.1343	.0043	3.33	.67
155	.0839	.1342	.0042	3.23	.65
160	.0813	.1341	.0041	3.13	.63

[1] This column can also be calculated by using the rating level as a base. For example: $\frac{45\text{-}40}{40} \times 100 = 12.5\%$.

normal times. The accuracy of the rating, therefore, should be measured in terms of the accuracy of the estimated normal time. Under stop-watch time study, accuracy of the estimated normal time is largely a function of the rating. Unfortunately this relationship makes it impossible to evaluate either. With objective rating films, however, this handicap is overcome, because the true normal time (T_{NC}) and the actual time are known. Thus, the correct rating coefficient can be calculated by $\frac{T_{NC}}{T_A}$.

In order to conform more clearly with our definition of rating as a technique for equating differences in operator performance, it appears more desirable to restate the rating equation as follows: $R\ (T_A) - T_{NC} = O$. This focuses attention upon the fact that, in theory, differences between performances will have no net effect upon the standard. That is, there will be no difference between the normal times for operators A and B because $[R_A\ (T_{AA}) - T_{NC}] - [R_B\ (T_{AB}) - T_{NC}] = O$, provided there are no errors in the estimation of R_A and R_B.

Objective rating films have been developed to improve rating accuracy. More often than not, there is some rating error. This absolute rating error in minutes (E_A) should be calculated by $E_A = T_{NC} - R\ (T_A)$. The percentage rating error (E_P) can be found by considering the difference between the rated normal time (T_{NR}), which is $R\ (T_A)$, and the correct normal time, divided by the correct normal time: $E_P = \frac{T_{NC} - T_{NR}}{T_{NC}} \times 100$. Thus, the closer (E) approaches (O), the more accurate the rating.

When using objective rating films, the usual procedure is to make the ratings in their entirety and then subject them to analysis. This analysis usually consists of plotting the rating values on coordinate paper with the ordinate designating the observed rating level and the abscissa, the correct rating. In some instances, computations of one or more measures of central tendency and even perhaps dispersion, are made.

The SAM Committee on Rating of Time Studies suggests the rating analysis form which is shown as Graph A. For the 100 per cent rating base, it contains rating levels from 40 per cent to 160 per cent distributed as indicated above. If further includes the "line of correct rating" with adjacent error margin lines of plus and minus 5 per cent. The included area is considered the "area of correct rating," and ratings which fall therein "are considered accurate from the practical standpoint.[5]

This graphical method of analyzing rating accuracy implies that a rating scale error of a given size is equally significant regardless of its position along the rating scale. In other words, if a rating of 115 per cent was made whereas the correct rating was 110 per cent, the rating scale error is 5 per cent; and if a rating of 85 per cent was made when the correct rating was 80 per cent, this would also be a rating scale error of 5 per cent. In short, the size of the rating scale error is determined by the absolute difference, along the rating scale, between the estimated rating and the true rating. This article, however, advocates that the percentage rating error be used for analyzing and controlling rating errors.

5 Society for Advancement of Management, *How to Use Performance Rating Films*, p. 14.

In order to examine the true significance of rating scale errors, Table 1 (Coefficients of Rating Error Effect) has been constructed. The values contained in this table have been derived by assuming a normal time of .13 minutes and a 100 per cent rating base plan. Column 1 represents the rating scale; Column 2, the actual time (T_A) corresponding to the appropriate rating level; Column 3, the estimated normal time (T_{NR}) assuming a positive 5 per cent rating scale error at each rating level. Column 4, is the absolute rating error in minutes (E_A);[6] Column 5, the percentage rating error (E_P);[7] and Column 6, the coefficient of rating error effect.[8] If a rating of 45 per cent is made and the correct rating is 40 per cent, the calculated normal time would be .146 minutes. The absolute rating error (E_A) is .016 minutes and the percentage rating error (E_P) 12.5 per cent. This means that a 5 per cent rating scale error results in a percentage rating error of 12.5 per cent at the 40 per cent rating level. Also, if a positive 5 per cent rating scale error is made at the 160 per cent rating level, this would result in a percentage rating error of 3.13 per cent. To generalize, an absolute 5 per cent rating scale error means a different percentage effect upon the normal time, ranging from 3.13 per cent at the 160 per cent level to 12.5 per cent at the 40 per cent level. In other words, *a given rating scale error at the 40 per cent rating level has 299 per cent more effect upon the accuracy of the normal time than if it occurred at the 160 per cent level.*[9] It, therefore, follows that the significance of a rating scale error is a function of its position along the rating scale. Rating scale errors at the higher rating levels being less significant (having less effect upon the accuracy of the normal time) than rating scale errors at the lower rating levels.

With this knowledge, it appears desirable to establish graphical methods for controlling rating errors which take into consideration the coefficients of rating error effect. Graph B has been constructed for this purpose. The rating scale error tolerance lines have been drawn on the assumption that a rating

Graph A

FILM RATING FORM

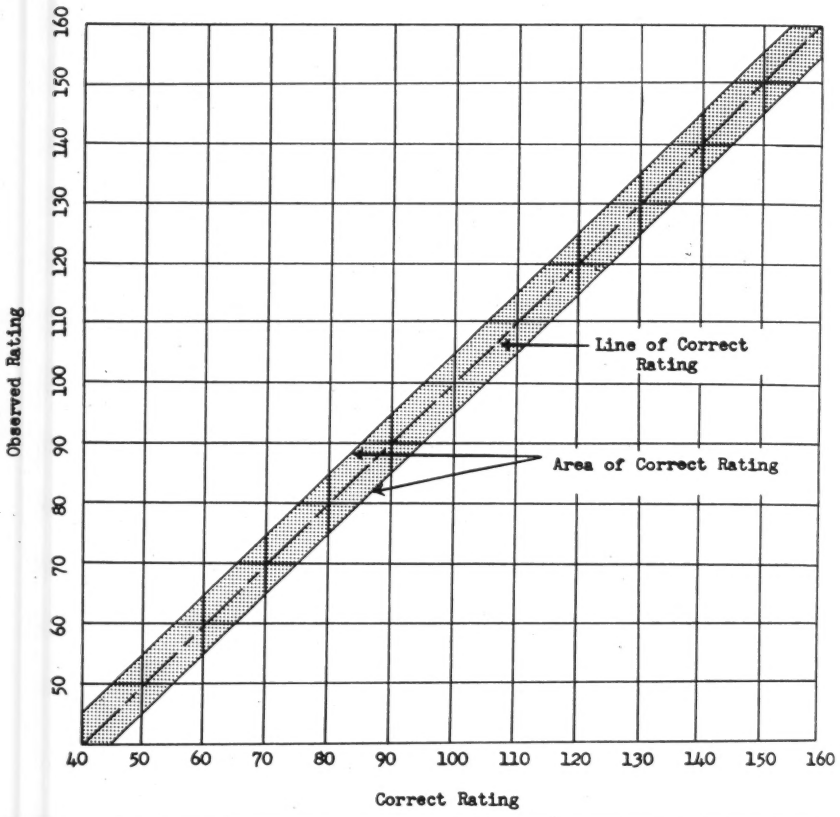


Table 2
RATING ACCURACY IN HARMONIC MOTION AND STROKING

Harmonic Motion			Stroking		
Rating Level	Mean Error (M_E)	Standard Deviation (S.D.)	Rating Level	Mean Error (M_E)	Standard Deviation (S.D.)
70	+15.4	16.2	75	+19.8	12.4
75	+ 7.5	11.2	105	+ 3.1	7.6
85	+ 6.4	8.6	120	— 9.5	9.5
100	+ .4	11.8	140	—11.8	10.4
130	— 3.7	9.8	150	—19.4	8.7

Table 3
ANALYSIS OF VARIANCE FOR MEAN RATING ERRORS
(Harmonic Motion and Stroking)

Source of Variation	Sum of Squares	D.F.	Mean Square	F. Value	Confidence Level 1%	Confidence Level 5%
Harmonic Motion						
Rating Levels	11,255	4	2,814	19.68	3.41	2.41
Experimental Error	37,086	260	143			
Total	48,341	264				
Stroking						
Rating Levels	49,750	4	12,438	105.4	3.41	2.41
Experimental Error	30,705	260	118			
Total	80,455	264				

6 $E_A = T_{NR} - T_{NC}$, or Column 3 values minus the correct normal time (.13 minutes).

7 $E_P = \frac{T_{NC} - T_{NR}}{T_{NC}} \times 100$, or the correct normal time minus the estimated normal time divided by the correct normal time multiplied by 100.

8 Coefficient of rating error effect $= \frac{E_P}{5}$. Errors are due to rounding.

9 See Column 5, $\frac{12.5 - 3.13}{3.13} \times 100 =$ 299 per cent.

10 If the firms acceptable rating scale error was plus or minus 10 per cent, the tolerance lines would pass through 150 ± 14.9, $\left(\frac{10.0}{.67}\right)$; and 100 ± 10, $\left(\frac{10.0}{1.0}\right)$ for the 150 per cent and 100 per cent rating levels.

11 *Rating Primary Quantities*, by A. D. Joseph Emerzian and Harold E. Smalley.

12 More than two years rating experience and have rated within last six months.

13 The simultaneous presentation of normal or standard pace and actual pace.

Graph B

FILM RATING FORM

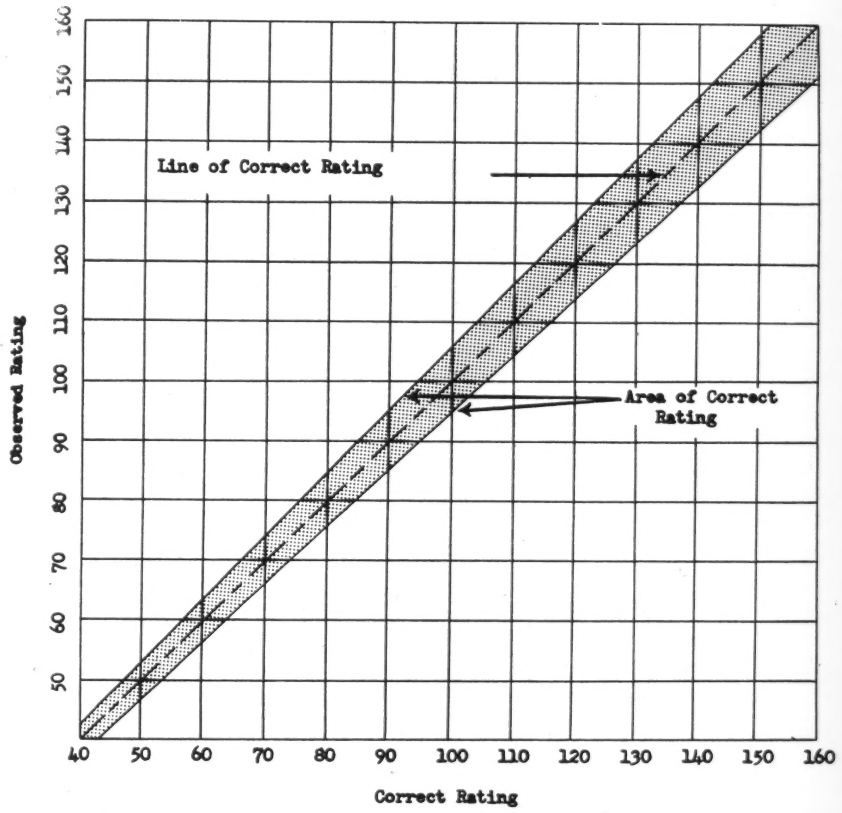


Table 4

HOMOGENITY OF VARIANCE OF HARMONIC MOTION AND STROKING

Quantiy Rated	χ^2 Value	D.F.	$\chi^2(4)$ 1%	$\chi^2(4)$ 5%
Harmonic Motion	24.87	4	13.28	9.48
Stroking	13.65	4	13.28	9.48

Table 5

STANDARD ERRORS FOR HARMONIC MOTION AND STROKING

Harmonic Motion		Stroking	
Rating Level	99% Confidence Interval	Rating Level	99% Confidence Interval
70	9.7 — 21.1	75	15.4 — 24.2
75	3.5 — 11.5	105	.4 — 5.8
85	2.8 — 10.0	120	— 6.1 — —12.9
100	—3.8 — 4.6	140	— 8.1 — —15.5
130	—7.2 — — .2	150	—16.3 — —22.5

14 This is calculated by subtracting the correct rating (R_C) from the actual rating (R_A): $M_E = R_C - R_A$. For a series of ratings it would be: $M_E = \frac{\Sigma (R_C - R_A)}{N}$

15 This analysis indicates that the sample F values for both Harmonic Motion and Stroking are considerably in excess of the sample F values which could normally be expected by chance alone at the 5 per cent and 1 per cent levels of confidence.

16 See A. J. Duncan, *Quality Control and Industrial Statistics*, Richard D. Irwin, Inc., 1952, pp 470-72.

17 The χ^2 values for both Harmonic Motion and Stroking exceed the $\chi^2(4)$ values at both the 5 per cent and 1 per cent confidence levels.

18 $\chi^2(4)$ at .001 = 18.465 and H = χ^2. H = 67,536 for Harmonic Motion and 164.523 for Stroking. It is readily evident that the differences in the size of the mean errors for the various rating levels are statistically significant. For an explanation of the statistical technique see William H. Kruskal and W. Allen Wallis, "Use of Ranks in One-Criterion, Variance Analysis," *Journal of American Statistical Association*, Vol. 47, No. 260, November, 1952, pp 583-622.

19 .995

20 Additional experimentation, whose design includes many more rating levels than are contained herein, is required. Such research is now underway.

scale error of plus and minus 5 per cent is acceptable to the organization. The slope of the tolerance lines was obtained by dividing the acceptable rating scale error by the coefficient of rating error effect. For example, at the 150 per cent rating level, the tolerance lines would pass through 150 ± 7.5, $\left(\frac{5.0}{.67} = 7.5\right)$; and at the 100 per cent rating level it would pass through 100 ± 5, $\frac{(5.0)}{1.0}$.[10]

Examination of Column 4, Table 1, discloses that the size of the absolute rating error in minutes (E_A), for a given constant rating scale error, decreases as one moves upward along the rating scale. With an assumed normal of .13 minutes, a rating scale error of 5 per cent at the 160 per cent rating level results in an absolute rating error of .004 minutes (disregarding sign), whereas the identical rating scale error at the 40 per cent rating level measures .017 minutes. The question which arises is whether it is easier to discern larger differences between actual performance and standard performance than smaller differences, or can a person do an equally satisfactory job of rating at any scale position.

In order to answer this question, some fragmentary data is offered in Table 2 (Rating Accuracy in Harmonic Motion and Stroking). These data were secured from an objective rating film produced at the University of Connecticut.[11] The ratings were obtained from 53 experienced time study men[12] rating pure speed, and using the direct comparison method of rating.[13] For each series and each rating level, a mean error[14] and standard deviation of the average amount of error have been calculated. The mean error is a measure of the rating scale error and the standard deviation a measure of variability.

One test which can be applied to determine whether there are significant differences between the accuracy of ratings at the various indicated rating levels is an analysis of variance. The question to be answered is whether the differences in the size of the mean errors are a function of the rating levels or whether they could have arisen by chance. These data were subjected to a single factor analysis of variance which is reproduced in Table 3 (Analysis of Variance for Mean Rating Errors).

This statistical test indicates that there is a significant relationship between the size of the rating errors and the position of the rating along the rating scale.[15]

It is important to consider whether the variability of the rating errors around

each mean error is consistent. In other words, are there significant differences in the variation of rating errors or of ratings at the various rating levels. To answer this question Bartlett's test for homogenity of variances was applied, and its results reproduced in Table 4 (Homogenity of Variance of Harmonic Motion and Stroking).[16] This test indicates that there is no consistent pattern in the variation of rating errors at the various rating levels.[17]

Inasmuch as the analysis of variance test assumes homogenity of variances, a second test must be applied for determining whether rating levels affect the accuracy of ratings. The test employed is a one-criterion variance analysis using ranks which avoids the assumption of homogenity. The results of this test indicate,[18] as did the analysis of variance, that rating accuracy is affected by rating levels.

What then is the nature of the effect of rating levels upon rating accuracy? To answer this question, Table 5 (Standard Errors for Harmonic Motion and Stroking) has been constructed. If each of the five means of harmonic motion and stroking for this sample does not differ from the true mean errors for the population, and the "odds" that they do not are .95,[19] each of the true mean errors lies within the 99 per cent confidence interval shown in the table. For harmonic motion the ratings at the 130 per cent rating level are as accurate (or inaccurate) as those made at the 100 per cent, 85 per cent and 75 per cent rating levels, and *more accurate* than those at the 70 per cent rating level. For stroking, the ratings at the 75 per cent rating level are *less accurate* than those at the 105 per cent, 120 per cent and 140 per cent rating levels, and are as accurate as those at the 150 per cent rating level. It would appear from this data that it is easier to rate above the 100 per cent rating level than below it in that ratings at rating levels the same distance above 100 per cent are as accurate or more accurate than ratings made the same distance below 100 per cent.[20]

Graphical methods for controlling rating accuracy should be constructed on the basis of the effect of the rating upon errors in the estimated normal time. Such graphs, therefore, should utilize the concept of coefficient of rating error effect developed in this article.

The evidence appears to indicate that rating levels influence rating accuracy, and that, given the same amount of point rating scale deviation, ratings will be as accurate or more accurate at the positive end of the rating scale. Therefore, for practical time study rating policy purposes where cut-off points for ratings are used, it would appear unreasonable to establish a rating range which went below 100 per cent as far as it went above 100 per cent. END

Will Your Chapter Be Represented in the BOOSTER CLUB?

This Booster Club was organized to give public recognition to members of SAM who are taking active part in the growth of The Society and thus rendering an even greater service to industry and the community.

Names of members who have been awarded membership in the Booster Club will appear in subsequent issues.

How many members will you have?

Names of members eligible for this club should be sent by the Chapter President to the National vice-President of Membership, Mr. Harold Fischer, Franklin & Marshall College, Lancaster, Penna.

MANAGEMENT MEETINGS*

April 22nd—THE PLANT LEVEL COST REDUCTION PROGRAM. SAM Pittsburgh Chapter. Hotel Webster Hall, Pittsburgh.

April 24th—HUMAN RELATIONS AT WORK. Industrial Management Institute, University of Wisconsin, Madison.

April 29-30—CREATIVE TIME STUDY AND METHODS. SAM-ASME. Hotel Statler, New York City. (see back cover)

May 21-22 — OPERATIONS RESEARCH IN MANUFACTURING AND MARKETING. Operations Research Society of America. Edgewater Beach Hotel, Chicago.

June 14-26 — IOWA MANAGEMENT COURSE. State University of Iowa, College of Engineering. Iowa City.

*See Chapter Activities, p. 28

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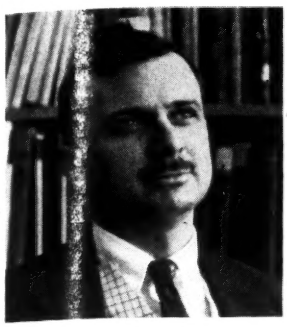

C. WEST CHURCHMAN has been, since 1951, Director of Operations Research and Professor in the Engineering Administration Department of Case Institute of Technology. His academic career includes instructorship and assistant professorship in philosophy at the University of Pennsylvania from 1937 to 1948, interrupted from 1942 to 1945 by his work at Frankfort Arsenal in Philadelphia as head of the Mathematics Department Ordnance Laboratory. He has also been Associate Professor of Philosophy at Wayne University. Mr. Churchman is the author of many works on the philosophy of science, the scientific method, statistical methods, operations research, and related topics.

Operations Research: An Evaluation

by C. West Churchman
Director of Operations Research
Case Institute of Technology

This article first appeared in print as a part of The Society's book called "Management Faces New Problems," which was the Proceedings of the 1953 Fall Management Conference. Because of the growing importance of the field, which was emphasized by the notable success of the SAM Operations Research Conference (January 28-29, 1954), this distinguished article is repeated here in full, to give the entire readership of Advanced Management a clear picture of OR.

THE war-time success of operations research teams has naturally suggested the application of such methods to modern industry. The questions that any contemporary industrial management asks about this field are these:

What is operations research?

Is operations research anything new as far as our company is concerned? Have we been practicing it for years under a different name?

What will operations research amount to *net* for our company? Is it worth our setting up an Operations Research team to study our problems?

I am sure that you will feel that anyone who has so directly put the issue must not proceed directly to answer the questions.

But before answering these questions, we must understand that management people are not the only people interested in operations research. There is another series of questions that can be asked about operations research, a series of questions at least as important as the first. These are the questions that would be raised by the academic mind.

What is operations research? Can you tell me so that a scientist can understand?

Is operations research anything new as far as science is concerned? Have we been practicing it in various fields for years under a different name?

What does operations research amount to as a possible area of study for the scientist? Is there any reason why a scientist interested in the discovery of facts and laws of the world about him should work with an operations research team?

One reason that operations researchers have had some trouble getting their ideas across to management has been that many of us try to answer both sets of questions at the same time. We don't want to say anything that will discourage management people from finding out more about OR, but we certainly don't want to have our scientific colleagues thinking that we're indulging in trivia, or that we have given up serious thinking. This is not to say that the two sets of questions are really different, but the language needed to give adequate replies is certainly different in each case.

Let us consider the academic questions first.

Operations research is a science. It is a branch of social science. It is that branch of social science in which one is concerned with the measures and methods of effective decisions of social groups. In other words, operations research is the study of group behavior from the viewpoint of the quality of the behavior; the quality of behavior refers to the effectiveness of decisions relative to a set of objectives. Operations research is not merely concerned with the descriptive study of such decisions of groups, but rather with the study of what constitutes the best available decision under various circumstances. In this respect it bears some analogy to medicine, which presumably is not only concerned with a description of the behavior of the physiological being but also with decisions that in some sense optimize the behavior of the individual from the point of view of preventing and curing disease.

There are some who would prefer to restrict the definition of operations research to the study of group decisions in which machines as well as men are involved. At the present time there is no

need to dispute the matter, for it is certainly true that almost all the activities of contemporary operations researchers are concerned with such machines as bombers, production machines, and the like. It does seem sensible, however, to keep the definition of operations research general enough so that a rigid terminology will not prevent the establishment of operations research teams for city planning, urban redevelopment, and so forth.

Is there anything new about a science which studies the effectiveness of group decisions? In a way, certainly not. Philosophy has always been concerned with the problem of judging the effectiveness of decisions, though philosophers have not always used the same terminology as operations researchers. A teacher of logic usually states that one of the primary purposes of the logic course is to teach the student how to think rationally. And certainly thinking is an important part of the decision process, and certainly rationality is a criterion of the effectiveness of decisions. A teacher of logic who emphasizes the importance of logic for training students to make rational decisions, is himself seriously concerned with the problem of the effectiveness of personal and group decisions. Economics, too, has always bee nconcerned in part with the decision process and the development of measures of decision-effectiveness. Management training programs supposedly have a similar interest.

How Is The Operations Researcher Different?

If one looks reflectively at the work of the operations researcher and compares it with that of the philosopher, logician, economist, management expert, and the like, one is struck by this difference: operations research teams study group behavior directly, often as members of the group, and are primarily concerned with the application of their results to the betterment of some one or more groups. One can say, but I think inaccurately, that the difference is a difference between applied and theoretical research. This is a rather bad way of putting it, since operations research definitely has an interest in the theory of decisions of groups, and economics and philosophy should have an interest in the applications of their findings. The difference is more analogous to the difference between what sociologists call "action research" and "survey research." The operations researcher becomes an active part of the group which he is investigating, while the survey researcher is (usually) an outside observer.

Whatever may be the distinguishing characteristic of operations research, it has definitely opened up vast new areas for scientific investigation that would never even have entered the imagination of our scientific fathers.

Everyone knows that even a relatively simple biological organism is really a very complicated piece of nature. Few of us, and even fewer scientists, have ever thought how very complicated too is the operation of a machine shop.

The Actual Operations Of The Shop

Let us examine briefly what goes on in this social organism called a shop. At various times during the day, orders enter the shop for certain products to be manufactured. Along with these orders, or shortly thereafter, certain raw material is absorbed. Then begins a fascinating digestive operation. The central nervous system (usually called the shop foreman) decides how the job order is to be processed. This decision would be relatively simple were it not for the fact that there are many other orders also being processed and there is already at work a rather complicated system of the utilization of the banks of machines. The new order must be digested without introducing tie-ups of equipment, and without introducing long waiting lines of material (since there is little storage space for in-process material).

A typical shop may receive some one hundred separate job orders a day. These orders may be processed through one or more of some twenty different types of machine. The sequence of machines which one order follows may be reversed by another, so that the two orders may arrive at the same place, each demanding attention, at the same time. We have learned through linear programming how one may, in certain cases, use the scientific approach to allocate the amount of work the seventh machine should do on the tenth order, but we do not have at the present time any general method for handling the *scheduling* of as many as one hundred orders on twenty different machines. Hence we may know how much time ideally should be devoted by each machine for each order, but we do not know how to put these time-elements into a rational sequence pattern.

Thus to the science of today, the ordinary shop foreman seems a genius. He figures out through his own ingenuity how to avoid tremendous crises in terms of unusual equipment or huge lots of material waiting to be processed. No one knows how good a job he really does, because no one knows enough about this very complicated organism man has created. We cannot say what the difference between the best operation and the present operation really is. But I am sure that all present budding, flowering and withering managers must acknowledge that in terms of complexity and genius of decisions, the job-shop foreman deserves accolades and raises.

The point I want to stress from the scientist's angle is that the job shop situation is repeated in all the other aspects of industrial operation. No one knows for most industries whether the maintenance program is a good or a bad one. All we know is that no serious break-downs occur, and (apparently) over-maintenance is not taking place in outlandish proportions. But how much does modern industry pay every year for its present maintenance policies as compared with the best maintenance policies?

Sales Department: The Oddest Management Element

That oddest of organisms, the sales department, presents an even more unknown creature of the land of industrial living. Here, the scientist is often at a loss as to how even to begin to make measurements in order to study and evaluate decisions.

Then there is top management itself. What role does it play in the organism? I don't mean, what role does it declare it plays, for it takes no great scientific acuity to see what this section of the organism claims its activities mean. A biologist now and then becomes curious as to what happens to an organism when a part is removed. Here is an organism that receives its messages through its sales department, sends the messages through its nervous system to the scheduling department, to the shop foreman, to shipping, back to the customer. The antennae of the sales department are effective feelers, the engineers keep the body healthy, the accountants warn it of dangers. What's left for top management? Perhaps a great deal, in the way of over-all planning. If this is the function of top management, then the scientist of group decisions has found another fertile area for investigation. What measures are relevant here, and how should the ef-

fectiveness of planning be studied?

In sum, operations research has opened our eyes to the immense possibilities of scientific research that lie within the area of industrial operations. Some aspects of this new field are already partially concerned, but the greater part still remains a fascinating and promising mystery.

Perhaps I can put the point of my remarks in other terms. We all hear a great deal about the marvels of the American enterprise; and sometimes hear from its critics a great deal about its defects. Up to the present time I would say that both sides of this issue have been indulging in a method that is abhorrent to the scientist: pointing out the obvious and ignoring the subtle. America has provided jobs for many and has shown a great increase in the standard of living. Obvious but as stupid as saying that America has allowed many to starve or die uneducated. The crux of the matter lies in subtleties, not simplicities. The urge to present our ideas simply so that simpletons will read them (and only simpletons will) is a blunder. The evaluation of the American industrial enterprise is as complicated a task as the determination of the interior of the atom. We don't know what industry could do if it did the best possible. We only know its outside skin. This is the job to be done if we intend to prove rather than persuade that our enterprise is best. And those that think otherwise, must likewise prove otherwise, not by police force, but by scientific force.

Operations Research: A Significant Sign

Operations research is a wonderful sign in our midst. Courageous men in the past have frequently spoken for a science of management. But now, I think for the first time, top ranking scientists are coming to regard the problems of the industrial organism to be as fascinating as the problems of matter and life.

Now for the actual meaning of operations research the management man. You want to know: What is this operations research? Do we have it now? If not, what will it cost us to get it? Will it be worth it?

To start with the question: is it new for industry today, or have we been using it for a long time under a different name?

The paradox is that either answer to this question is bad and dangerous. In this respect, the question itself is like the question "Have you stopped beating your wife?"

If one says that there is nothing new in operations research, and that in fact many companies have been using it under another name for some time, one runs the very real danger of leaving the impression that the techniques of OR are really "old hat." Actually, no company can have been using most of OR for a long while, for most of OR as it is practiced today is of very recent vintage. Linear programming, game theory, sampling theory, probability inventory models, decision theory with uncertainty, small group behavior, are all post-war developments. And these techniques are all part of the normal activity of the operations researcher, and in a sense characterize the way he attacks problems. One is apt to be deceived by this kind of fallacy: we used some mathematics to solve this problem, OR uses mathematics to solve its problems, hence we have been using OR. You have been using OR, under the name of OR or any sweeter name, only if you have kept up with the latest developments in the fields I mentioned as well as numerous other developments.

Is Operations Research Actually New?

On the other hand, if one says that OR is "new," one immediately creates the impression that here is a method that will scientifically and more or less automatically solve all the problems that beset business administration: a new formula that will cure everything from jitters in the accounting department to headache in packaging! This impression is just as bad as the impression that every company has been doing OR under a different name. There is nothing essentially new in the idea of applying scientific methods to industrial administration. What OR does is to suggest certain modern patterns of thinking that have proved extremely valuable in certain scientific areas. Whether these patterns of thought will prove useful to you in your business is something else again. The answer depends, not on a magic formula, but on the availability of data, the cooperation of members of your company, and the receptivity of your management, to mention just a few of the factors. There is not now, nor will there ever be, any formula that will immediately prove its worth in the solution of management problems. Industrial statistical quality control found this out the hard way: it was a long up-hill battle to make even a dent in the inspection policies of most companies. And the companies themselves found out that statistical quality control was no secret formula that could cure all their ills.

The point is after all a simple one. If you are going to try to apply a new way of thinking to your business, even if it's only moderately new, you're going to have to work hard at it, both you and the OR team. It's a tough job, and no one has the simple answer. Of course the problems of your company are "different," so that when you hear the success of an OR project for another company, you instinctively say to yourself, "but that wouldn't work here." This is why the demand for cases worries us so much in talking about OR. A good case history may show you how OR works but it is just as apt to convince you that it won't work for your company because your company is so different from the company in the case example. The problems of every company are different from every other company; furthermore, the problems of every company are much worse and far more complicated than the problems of any other company. As a psychoanalyst might put it, "everybody suffers equally; that is to say more than anyone else." That's the tough job you have to face if you plan to take OR seriously: you're not going to find receptivity of your management, to men-magic formulas. You're just going to find a lot more work for yourself and everyone else you involve in the project.

Will it be worth it? Or, as I phrased the matter earlier, what is OR *net* for your company?

Can Anyone Tell What OR Nets?

This is a question that no one can answer adequately until he knows your company well. It may start some thinking on the possibilities of OR to ask questions like the following:

1. Do you know that customer demand, though quite variable, may follow a fairly well specified probability law? That as a consequence, one can set up an equation in which set-up costs, raw material costs, customer demand, and inventory costs appear, and derive therefrom the optimum scheduling and inventory policy? That one can do this job even when the cost of the customer shortage is virtually "unknown"?

2. Do you know that in many cases sampling techniques can reduce the costs of examining routine reports, orders, and so forth, to one-tenth of the costs of examining every item, and often with a

better accuracy than the 100 per cent count? That cost equations can be set up for information, just as they can be set up for other aspects of the business?

3. Do you realize that policies regarding capital expenditures can be translated into alternatives that can be handled mathematically and accurately?

4. Do you realize that the problem of allocation of time and cost in a bank of machines, or among salesmen, can be handled mathematically by a series of linear equations and inequations?

5. Do you realize that though breakdowns of machines occur irregularly and apparently unpredictably, nevertheless these breakdowns may follow probability laws, so that an exact and most economical policy of inspection and replacement can be worked out?

6. Do you know that sociologists have been studying intensively the communication process in small groups, with the result that by their methods one can evaluate the effectiveness of committees, planning groups, etc.?

All of these questions really revert to the academic discussion; despite the odd fluctuations of your business and the number of variables that influence the outcomes of your decisions, scientists have built up, and will continue to build up, methods for attacking these problems, so as to provide a solid proof that what is done is the best that can be done.

Note that scientists "will continue" to build up methods for attacking these problems. We have only scratched the surface, but in the last few years the number of new techniques that have been made available to the business executive is phenomenal. What is not so obvious now may become all too obvious before long: your company cannot afford to be without a team that can keep abreast of what is going on in mathematics, probability theory, statistics, game theory, and other such developments.

At least this much I can recommend: that you see first of all whether there is a right environment in your company. Is there opportunity for an OR team to start working on problems and, most important, to gain acceptance if they come out with results? If there is no opportunity, there's no point in thinking any further: opportunity is the life-blood of every OR effort today.

If there is opportunity, then select one or more persons from your company to form the nucleus. Get outside help to come in and to talk to your management. Get them to work with the nucleus on a mutually satisfactory problem. Never use the consultant as a "one-shot" specialist. He should be there to train your own personnel, for the objective should be to have a regularly operating OR team in your own company. Be careful to avoid the other danger: an individual who knows a little mathematics and statistics and sees this as a chance to push some of his own unsubstantiated ideas or ambitions. Be sure your consultants really train: and by training I mean the activity of instilling enough information so that the person in charge knows when and where to go for help. In a year's time you may well be in the position where you have an active OR group, that is aware of what's going on in the journals and books, that knows who can help them.

OR is a social science and could be called by another name. It means translating the latest scientific developments into techniques that will aid company policy, seems to hold real promise both for science and for industry. But much more important is the fact that operations research represents an exciting and tremendously promising possibility of studying the decision-making process, and perhaps for the first time through it management men can begin to understand what rational behavior really means. END

SAM Chapter Performance Awards Report

for period—July 1, 1953-February 29, 1954

CHAPTERS	TOTAL	CHAPTERS	TOTAL
Worcester	13,095	Reading	4390
Kansas City	12,331	Greenville	4283
Lancaster	9391	Richmond	4211
Western N. C.	7519	Western Mass.	4159
Clearing	7487	Knoxville	4114
Trenton	7215	Providence	4083
Raritan Valley	6590	Manchester	4012
Northern N. J.	6199	Boston	3732
Nashville	6140	Indianapolis	3293
Baltimore	5972	Fox Valley	3263
Pittsburgh	5942	Washington	3176
New Haven	5908	San Francisco	3067
Central Pa.	5852	Chicago	2953
Milwaukee	5565	St. Louis	2895
Greensboro	5443	Central N. Y.	2818
Philadelphia	5411	Cleveland	2260
Hudson Valley	5322	New York	1954
Portland	5145	Wilkes-Barre	1806
Detroit	5113	Charlotte	1559
Dallas	5108	Sacramento	1533
Lehigh Valley	5068	Twin City	1399
Montreal	5006	Bridgeport	910
Atlanta	4880	New Orleans	304
Columbus	4853	Louisville	248
Birmingham	4822	Los Angeles	223
Binghamton	4797	Dayton	50
Wilmington	4779	Stamford	50
Hartford	4425	Calumet	—
Madison	4396	Cincinnati	—

Nominees for SAM National Offices

GEORGE B. ESTES, nominated as the next President of SAM, is its current Executive Vice-President. A Worcester Polytechnic Institute alumnus, he has served many major firms, including B. F. Goodrich, Eastman Kodak, Ford, General Motors and is now Vice-President of The Seeger Refrigerator Co. He has been charter member, President and National Director of SAM's Worcester Chapter; has served on SAM's Executive, Finance, and Time Study Rating Committees.

FRANCIS F. BRADSHAW, nominee for SAM's Executive Vice-Presidency, is President of Richardson, Bellows, Henry and Company. Dr. Bradshaw, who has spent most of his career in personnel research, was a War Department field consultant in World War II, developing officer selection procedures, for which he received the Certificate of Appreciation. Dr. Bradshaw, a SAM Director for several years, is a Board member of the New York Chapter.

JAMES E. NEWSOME, nominated as Secretary of SAM, is Supervisor of Cotton and Filter Mills for Johnson & Johnson. Mr. Newsome is a former Industrial Engineer, Foreman, and Training Director of United States Steel Corporation; was Continental Can's Assistant Manager of Industrial Relations His SAM service includes terms as President and Vice-President of the Chicago Chapter, and as National Vice-President for Chapter Operations.

JOHN B. JOYNT, re-nominated as Treasurer, is Manager of American Enka Corporation's Administrative Engineering Department. A well-known name in administrative planning and management control, Mr. Joynt has held positions with manufacturing, banking and transportation companies, as well as with federal, state and municipal government. A former management consultant, he served on General Somervell's Management Control Staff, was awarded the Legion of Merit. He assisted in reorganizing General Bradley's Veteran's Administration after the war.

(Air travel will be paid to National Directors attending the policy meeting and election of officers at the National Board Meeting on May first.)

DICKSON RECK, prior to his present position as lecturer at the University of California, was consultant to the American Standards Association (1951), an official of the SCAP government in Tokyo, a specialist serving the State Department and OPA, as well as functioning in several academic positions at Columbia and Pennsylvania Universities. He began his career in 1927 as assistant to the President, Square D Company of Detroit. Mr. Reck has served the Chinese government as advisor in industrial relations, and several of his numerous published works have been translated into Chinese. From 1952 until the present, he has been Advisory Fellow of the Mellon Institute, and is a member of the American Economics Association.

The Role of Company Standards In Industrial Administration

by Dickson Reck,
Lecturer in Business Administration,
University of California

This top-level article on standardization is one of the earliest results of the Standardization Fellowship sponsored by the Sarah Mellon Scaife Foundation at Mellon Institute, Pittsburgh, Pennsylvania. This is the first research program to be focused directly on the economics of technology. The program's studies are extensions of the idea that well-conceived programs of standardization can increase efficiency.

STANDARDS are well accepted by most business executives and writers on management as essential for the administration of any industrial organization. There is, however, no general agreement on what is meant by the term "standards," how broadly standards are applied in a company's operations, or what their basic significance is for administration. Practical reflections of this vagueness are found in the uncertainty with which many executives view standards programs. This uncertainty stems in part at least from the fact that there has been no broad and clear-cut analysis relating the uses of standards to the principles of administration.[1] To provide such an analysis, the logical approach is to analyze the administrative processes in terms of the role played in them by company standards, adapting for this purpose a classification of the basic processes of administration selected from the current literature.

The word "standard" will be used here to mean a model. This agrees with general usage, except that the general concept is not limited to models resulting from conscious decisions nor to those used repetitively. Customs or habits which are called standards in general language, are not standards in the present sense unless they are adopted by conscious administrative decisions. If a decision is used at two or more points in time, it will be considered to be used repetitively. A budget which applies to a single period of time is a standard because it is referred to repeatedly during the time it is in force. Similarly, a product design for a unique piece of equipment is used repeatedly to direct and control production of the equipment, and is therefore a standard although the product itself is called a "special." Thus the great majority of the important administrative decisions are crystallized in standards. The restricted meaning is also very broad in other senses. It includes oral, written, and physical standards; it includes standards selected by consciously-made decisions based either on experience or hunches, or an elaborate research and analysis.

Types of Standards. Standards can be arranged according to their position in a scale ranging from general to specific, and can be classified into the following pairs of subclasses, each pair of which includes all standards, (1) substantive and procedural, (2) oral and written, and (3) intra- and inter-departmental.

The arrangement of standards according to their degree of generality with respect to the scope of activities they cover, will be used below to clarify the concept of a system of standards and its function of integrating and coordinating operations.

Substantive standards are work-content or goal-oriented, while procedural standards are methods or relationships-oriented. In general, substantive standards define *what* is to be accomplished while procedural standards define *how* it is to be accomplished.[2] In practice this distinction is quite essential, because substantive standards may be complied with by applying any one of a number

1. Although no rigorous treatment focussed on standards is available, the relationships between standards and administration have, of course, often been discussed. See H. S. Person, "The Development and Influence of Scientific Management," *Advanced Management*, (October, 1940).
2. This distinction parallels that between substantive and procedural planning and coordination used by Herbert A. Simon in *Administrative Behavior* (New York: Macmillan, 1948).

of alternative procedural standards which differ in efficiency. Effectively indentical parts, for example, may be produced by different methods.

Table 1 may help clarify the distinction between substantive and procedural standards and the order of their generality.[3]

The need for distinguishing oral from written standards is obvious, although the decision to use one or the other is frequently very difficult to make. The distinction between intra- and inter-departmental standards is, of course, relevant in analyzing the organization of standards work.

The Administrative Process. Administration is characteristically analyzed in terms of the basic processes it encompasses. According to one classification, which provides as good a starting point as any, administration includes the following processes: planning, organizing, executive personnel staffing and training, directing, coordinating, and controlling.[4] To bring the role of standards into focus it is useful to recast this classification. Decision-making is substituted for planning which seems to exclude intuitive decisions made on the spur of the moment. Organizing and executive personnel staffing are not included because they are not always required to carry out administrative decisions.

With these changes in mind the administrative process may be restated in terms which bring into focus the role played by standards. Whenever repetitive situations are the subject matter, administration involves:

1. Decision-making, which in turn involves:
   a. (in cases where conscious analysis is made) searching and researching to find the alternative solutions which hold forth the prospect of being the most desirable ones for achieving the objective sought,
   b. (in all cases) deciding on one solution which is estimated to be the most efficient one economically available for reaching the objective,
   c. (in all cases) crystallization of the decision in the form of a standard appropriate for communication;
2. The use of the standard as a model to be followed in directing operations;
3. The use of the standard as a model to be followed in training personnel;
4. The use of the standard as the basis for comparison in controlling operations;
5. The use of the standard as a part of the company's system of standards in coordinating operations; and
6. Periodic repetition of the processes, that is, continuing research to find better combinations, decisions to adopt them, and consequent revisions and applications of standards, whenever advances in the state of knowledge make such action economical.

Before elaborating upon the use of standards in each of these processes we must consider the role played by standards in communication.

Communication. The efficiency of decision-making, directing, training, controlling, and coordinating is in every case dependent on the establishment and maintenance of an effective system of communication. Any effective system of communication in turn depends on the use of words and symbols, all of which are standards.

Common Language Does Not Always Work

Common language is never sufficient for communicating ideas in an industrial organization. Every industry, science, technology, and profession has its specialized terminology, as in some degree does each company. Company standards for technical terms to supplement the common language, whether they are settled upon by the same informal processes by which common language becomes standardized, or by formalized procedures consciously conducted by organizations, are a necessity not only for conducting the internal operations of the company, but for dealing with customers, suppliers, government agencies, and other organizations with which it has relations.

The Complementary Roles of Research and Standards in Decision-Making. Many decisions are made by executives by reference to their own experience, and are in essence determined by informal analysis or intuition. Many other decisions are made only after consciously conducting formal analysis involving more or less extensive research and the cooperative effort of many individuals. In either case the process of decision-making at any level of the organization is always guided by an objective established by a previous decision made at a higher level. This objective is a substantive standard which (1) limits the field of inquiry within which are sought the alternative solutions holding forth prospects of being the most effective ones economically available, and (2) provides the criteria for measuring the effectiveness of the alternatives in the process of selecting the one to adopt.

When a decision is made, the solution selected becomes the standard which is communicated to those whose activities are to be guided. The alternatives as they are presented for decision may be in a form ready for communication as standards, but normally the one selected needs to be reformulated after the act of decision. Regardless of the sequence in which they are made the two steps of decision and preparation of the standard require different competence which is often provided by different people.

What To Do When Decision Involves Analysis

When decision-making involves conscious analysis and cooperative action, competent experts are usually drawn into the process, and often alternatives are developed by a series of approximations until the ones are evolved which are judged to be the most efficient in terms of the probability that they will contribute the most to the attainment of the ob-

Table 1
TYPES OF STANDARDS USED IN INDUSTRIAL ENTERPRISES

Degree of Generality	Substantitive Standards (work content, goal-oriented)	Procedural Standards (methods- and relation ships-oriented)
General	Objectives Budgets	Procedural policies Organization structures and relationships
	Product line	General programs
	Plant layout	Administrative procedures
	Performance standards (in terms of costs, quantity, or quality) for personnel, facilities, products, assemblies, parts, and materials	Detailed programs Clerical procedures Production operation methods
Detailed		Inspection methods

3. Compare William H. Newman, *Administrative Action*, (New York: Prentice-Hall, 1951), Figure 8, p. 54.
4. From Newman, *op. cit.*, Table of Contents.

jective. Such decisions are composite decisions and may involve hundreds or even thousands of subsidiary decisions in which dozens of experts at various organizational levels have participated.

Many Research Problems Are Recurrent

A large portion of these subsidiary problems met with in research are recurrent and the solutions for them are provided by standards. Such are the published standards for materials and commodity characteristics, safety factors, engineering design elements, methods of test, methods of rating, formulae, classifications, procedures, standard equipment, and weights and measures, which are required for efficient research, not only in the fundamental and applied physical sciences, but in the social sciences as well. These and many other types of standards provide tested answers ready for use and greatly hasten the process of research.

Standards not only define the objectives and provide tools for decision-making, but frequently stimulate needed research. Formalized standards development procedures often demolish comfortable preconceptions and lead to re-appraisals of the data and the analysis upon which the standard in use is based. As a result, further research is conducted and a more adequate solution evolved than when informal decision-making processes are relied upon.

Finally, unnecessary duplication of research effort is avoided by standards. Solutions are preserved for future use, especially when standards are written, and there is no need to repeat the research when problems recur. The time of research workers and executives is thus conserved, and if left free for work on unsolved problems.

Directing. Directing is the administrative process of communicating to subordinates decisions and authoritative instructions for carrying them out. From the present viewpoint it is a process of communicating substantive and procedural standards to subordinates.

One function of standards in directing is to increase the precision with which ideas are communicated. This is accomplished through careful formulation of the standards which embody the decisions. It is a function which is closely related to training.

In addition to increasing the precision of communication, standards serve the vital function of eliminating the necessity for spending time and energy in directing recurring operations. Once communicated, such standards serve repeatedly as models to guide operations. They bring the exception principle into play; only nonstandard exceptional situations need be referred by subordinates to executives for direction. As a result, less time is required to direct a given scope of operations and an executive can either direct a larger number of operations or be freed for planning or other activities. At the same time, subordinates are freed from the necessity of frequent consultations with their superiors.

Training. Written substantive and procedural standards provide tools for instruction and subject matter for study in the training process. These functions are performed by both the standard technical terminology of the business, and the standards applying specifically to the operations in question. Such standards are used not only in formal instruction, but also for repeated reference by personnel during the learning period when procedures are becoming matters of routine. Routine is the organizational counterpart of habit in purely personal activity. Standards define organizationally acceptable procedures by which repetitive activities are to be performed. Once learned, these standard procedures are performed automatically and the need for repeatedly thinking through the sequence of steps in the operation is eliminated. The result is faster performance and less expenditure of mental effort. This process of reducing operations to routine is one of the principal functions of standards.

Verbal Standards Must Be Remembered

Verbal standards can have the same effect as written ones in directing and training *if* they are remembered, but written standards perform the additional function of providing a de-personalized "memory" for the organization. Verbal standards exist only in the know-how of individuals, and if the individuals leave the company the know-how departs with them. The result is at best a difficult task of training replacements and at worst, where key personnel are involved, a loss of techniques sufficient to cause a serious reduction in operating efficiency.

Recognition of this need for de-personalizing know-how often prompts the establishment of written standards. A national food processing concern found itself in a potentially embarrassing situation a few years ago when several of its top executives reached retirement age or for other reasons left the company. A significant portion of the technology of the company existed only in the minds of these men. While they were with the company, operations went smoothly enough without written standards, but when they left, the efficiency of the company was threatened. As a consequence a department was established under a vice-president to coordinate the standards development and quality control work of the company, and to reduce strategic decisions to written standards. In the future this de-personalized know-how will be available to facilitate the training of new employees and minimize losses in efficiency resulting from the turnover of skilled personnel.

Controlling. The substantive standards employed in directing are used in identical or closely related forms in control, which completes the administrative cycle of decision making, direction, and control.

Just How Are Standards Really Controlled?

Control is the process of checking results against substantive standards and feeding back the comparisons to executives for appropriate action. When such reports reveal errors resulting from inadequate performance of operations, sanctions are applied to operating personnel, and when they reveal errors attributable to inadequate standards the information is relayed to the decision-making personnel who re-examine the standards, make new decisions and revise the standards. In this way control operates to feed back information on errors and to reactivate the administrative cycle so that a closer approximation to the best solution is found and applied to operations. Standards are essential for control since they provide the models for measuring performance and reporting errors.

The standards used for formally established control by supervisors can be only a small number of the total required to guide a company's operations. One large electrical manufacturing company, for example, estimates that the number of standards applied to its operations exceeds two million. Obviously only a small portion of these, selected because the operations they measure are strategic, can profitably be used for supervisory control. Control, however, is also exercised informally by all subordinates when they apply detailed standards to operations. Each standard is used by

someone—an executive, a supervisor, or an operating worker—to guide and control the performance of some operation; otherwise the standard serves no purpose and can be profitably eliminated.

Coordinating. The process of decision-making begins with the most general objective—usually, in private businesses, profit maximization in the long run—and moves through successive levels at which standards are progressively more detailed. The standard arrived at by a decision at each level is linked to its objective which is a standard arrived at by a decision at the next *higher* level, and in turn is the objective to which are linked the standards arrived at by decisions at the next *lower* level. By this process the linkage of standards reaches down and branches out in the organizational structure ending in a very large number of detailed standards—more than two million in the case of the electrical manufacturing concern previously mentioned—which guide the myriad of detailed operations in all departments of the firm. It is only after these final detailed operations of the company have been guided by the final and most detailed standards in the hierarchy that any degree of achievement of the general objective of the company is attained.[5]

Coordinating is the process of harmonizing operations so they all contribute to a common objective. The hierarchy of standards with its ramifications comprises an integrated system which serves the vital function of establishing and maintaining coordination of the firm's operations. To the degree that each standard in the system is well articulated with those at higher and lower levels, the final operations will be in harmony.

An example will help to clarify this concept of a system of standards. For an imaginary electrical manufacturing company, there are listed in Table 2, in rough order of their generality, some of the important decisions and their corresponding standards which guide the performance of the research, engineering, and production functions required to manufacture a single item of the company's product line, in this case an electric switch. Eleven standards, or types of standards, are shown in the hierarchy, but these include many thousands of detailed standards. It would be possible to construct similar schematic representations of all the hierarchies of standards required for performing all the other functions involved in manufacturing and selling this single item, for example the sales, purchasing, finance, and personnel functions. If these hierarchies were combined the resulting composite system would include many thousands of standards, and only after each of them had been applied in directing and controlling operations would the company realize its objective of making a profit from the sales of this one switch item.

If the product line of the company includes 1,000 items of switching equipment, 1,000 similar systems of standards would exist. The general standards in all the systems would be identical down to and including the product line, and a large proportion of the detailed standards, those related to common technical terms, parts, and common sales programs, for example, would be common to a substantial number of the systems. If the 1,000 systems are thought of as being interconnected by their common standards, there emerges the concept of a single system of standards.

The coordinating function of such a system of standards is not difficult to visualize. If the production of a single part which enters the assembly of the switch in the example above is to make its expected contribution to the profits of the company, at least the following standards must be carefully coordinated: the detailed design standards for the part; the detailed design standards for the sub-assembly of which it is a part; the purchase and inspection standards for the material from which the part is made; the standards for the speeds and accuracy of the equipment and for the tools and fixtures by which the part is made; the production operation standards; the standard times for the operations; the standard costs for the part; the personnel standards for selecting the operators; the wage rates; and the inspection standards for the finished part. If the part is sold as a repair part, standard product data, standard prices, standard terms of sale, and standard customer classifications provided to salesmen would also be included. Only if all these standards are harmonious will profits, so far as this part influences them, be maximized.

Dynamic Equilibrium of the System of Standards. The foregoing picture of the role played by standards has been simplified in order to bring out clearly its significance in the administrative process. In actuality, objectives are often complex, decisions composite, and systems imperfectly articulated. Above all, systems of standards are never static, but are constantly in the process of change.

Decisions seldom, if ever, result in ideal standards. Standards, therefore, are never precisely articulated into a perfectly integrated and coordinated system. Any standards may be loose in the sense that it tolerates too wide variations in procedural or substantive content to relate operations with ideal effectiveness to their objectives. This looseness may be economically desirable if losses due to

Table 2

SOME IMPORTANT DECISIONS AND STANDARDS IN THE SYSTEM COORDINATING THE PRODUCTION OF AN ELECTRICAL SWITCH IN A HYPOTHETICAL ELECTRICAL MANUFACTURING COMPANY

Decisions	Standards
1. To form a corporation with the objective of maximizing profit from the investment of capital in a manufacturing enterprise.	1. Oral or written agreement of the promoters.
2. To engage in the manufacture and sale of electrical equipment.	2. Purpose clause of the corporate charter.
3. To manufacture a particular line of low voltage electrical equipment.	3. The company's catalog and sales data sheets defining the product line.
4. To manufacture a particular type of switch included in the product line, to be called catalog number 38,372, which will perform as well or better than competitive switches.	4. Prototype model of proposed catalog number 38,372, developed by the research department.
5. To manufacture 38,372 following a particular detailed design involving a multitude of decisions covering design details for the final assembly, each sub-assembly, each manufactured part, and each purchased material and part.	5. Complete detailed engineering design drawings, bills of material, and supplementary written specifications for the final assembly, each sub-assembly, each manufactured part, and each purchased material and part.
6. To invest in tools to manufacture catalog number 38,372.	6. Standards for equipment, tools, dies, and fixtures for the final assembly, each sub-assembly, and each manufactured part.
7. To produce certain quantities of 38,372 to meet forecasted demands.	7. Standard order quantities for the final assembly, each sub-assembly, each manufactured part, and each purchased material and part.
8. To use certain production methods for the final assembly, each sub-assembly, and each manufactured part of 38,372.	8. Standard operation sheets showing the tools and routing to be used for producing the final assembly, each sub-assembly, and each manufactured part of 38,372.
9. To install certain inspection procedures to control the production of 38,372.	9. Standard methods of sampling and inspection.
10. To produce the final assembly, each sub-assembly, and each part within certain times.	10. Standard times for each operation for producing the final assembly, each sub-assembly, and each part.
11. To produce the final assembly, each sub-assembly, and each part at certain costs.	11. Standard costs for the final assembly, each sub-assembly, and each part.

5. This concept parallels that of a hierarchy of decisions, see, for example Chester I. Barnard, *The Functions of the Executive*, (Cambridge, Harvard University Press, 1951), pp. 196-197.

imperfect coordination are less than the costs involved if the standards are tightened. Many standards are arrived at by snap decisions or hunches, and are not written because it is uneconomical to spend the time to plan their construction in detail and to reproduce them in writing. The looseness, however, may be economically undesirable and may exist because of bad decisions, because individuals apply oral standards loosely, because standards which should be written are not, or because standards have not been revised to relate them properly to changed objectives or to take advantage of newly acquired knowledge.

No Organizations Have Written Standards Systems

In no organization is the complete system of standards neatly recorded in written form. In very small organizations the system may be completely retained in the know-how of the owner-manager. In medium-sized and large organizations, the essential framework of the system is typically recorded in yearly budgets, organization manuals and charts, books of administrative policies and procedures, the catalog of the company's products, the files of engineering process and product design drawings, manuals of engineering standards, files of standard operation sheets, files of standard times, files of standard costs, manuals of standard operating procedures and forms, and sales manuals. The complete system is never recorded and preserved inasmuch as it includes many oral standards.

Standards act to concentrate each operating practice on the method currently deemed best, and to coordinate all practices into a harmonious whole. If the decision making process is functioning properly, standards are revised whenever changes become economical. Ideally, standards in the system are frequently changed but at any moment in time the system is in balance. The result is purposeful progress by maintaining operations in dynamic equilibrium.

In summary, a well-constructed system of company standards in industrial administration serves:

1. To increase the precision and speed of the decision making process by providing an objective which (a) limits the field of inquiry in which alternative solutions are sought, and (b) furnishes the criteria for measuring them.

2. To facilitate communication in all administrative processes by providing the specialized technical langauge needed to supplement the common language.

3. To facilitate, in directing and controlling, the communication of solutions selected by decisions and to preserve the solutions for future use, by crystallizing them in readily understandable forms.

4. To conserve research effort and reduce the work-load of executives and subordinates by avoiding the expenditure of time and other resources in repeatedly solving recurring problems.

5. To increase the efficiency of preforming repetitive operations by standardizing them and then reducing them to routine through the training and learning processes.

6. To coordinate operations so their contribution to the general objective of the organization is maximized by providing directions and controls with systematically related substantive and procedural content.

The efficiency with which an organization achieves its objective is determined substantially by the adequacy of its system of standards. This adequacy depends on how effectively the standards programs and development procedures are organized. The foregoing analysis of the role played by standards in administration has implications for the effective organization of standards programs which can be touched upon only briefly here.

What Special Problems Do Standards Make?

For those who feel that standards pose special problems in industrial organization, the most significant conclusion is that since standards play an integral part in every step of administration, the programs for organizing standards development and applying standards are precisely those of organizing the decision making process and applying decisions throughout the firm. It may help to bring out the significance of this view if the questions posed at the outset of the article are re-stated.

Should a Company Embark upon a Standards Program? Since standards aret co-extensive with administration, every company has standards programs which blanket its operations, even though it may have no program which is called a "standards program." The question is really irrelevant—the relevant questions are concerned with the adequacy of the procedures and organization structures through which standards are developed.

What Procedures are Best for Developing Standards? Standards development procedures include all the procedures by which decisions concerning repetitive problems are made. In view of the wide variations in the number of departments affected by, and in the complexity and importance of such decisions, it is clear that no one procedure can be the most efficient for all types of standards. Several procedures, each fitted to the needs of a class of standards, are required.

Where in the Organization Should Responsibility for Standards Development be Placed? There can be no completely centralized standards department. Intra-departmental standards which have little effect on other departments are logically the responsibility of each department; centralization of several groups of related types of interdepartmental standards at points where communication between those who are competent to develop them and those who are primarily affected by their use, is logical. Any sizable firm will then typically have a number of departments specializing in interdepartmental standards work, such as a budget office, an industrial engineering department, an engineering standards department, and a cost department, but the top coordinating standards department is the president's office. Where segments of the system of standards are inadequate, as is sometimes the case with engineering standards, strong top-management backing of a standards department is required.

Do Standards Straitjacket Operations and Hold Back Progress? There is no question but that inadequate and poorly devised systems of standards do straitjacket operations and hold back progress. Since standards are an integral part of administration, however, there is no choice of whether or not to use them. It is not standards per se, but the failure to arrive at adequate standards which straitjackets operations. The corrective is to improve the process by which decisions are made so that the standards are right. Similarly, it is not standards per se, but the failure to revise them which retards progress. The corrective is to adopt a procedure by which standards are reviewed and changed whenever change is economical so that operations progress from the level defined by current standards to the new level made possible by research and defined by new standards.

Far from stultifying operations, adequate standards developed by effective procedures, are the principal means of reducing solved problems to routine, and freeing personnel for working on the unsolved problems which, when solved, permit the firm to progress. Well designed standards liberate initiative. END

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Steps Toward Economic Understanding

by John Burger
Director, Educational Services
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Management's place in the community is an important and ever-pressing issue, and one easily neglected. By taking active part, today's management men can meet a challenging opportunity to satisfy a vital human need. The author of this article took part in such a plan for a large corporation (General Mills, Incorporated, of Minneapolis), and explains here exactly how alert management can take its proper part in community life.

MORE than 3,000,000 new boys and girls enter the schools of America each year. As they proceed through their school careers they learn about themselves and their environment. They learn about the world in which they live and about the other people in it. They learn history and geography. They acquire information and skills that fit them for more effective living.

By the time these young people reach the age of 10 or 12 years, they are having daily experiences with far-reaching economic implications. They are working as producers—delivering groceries or newspapers, baby-sitting, mowing lawns, collecting and selling old paper and scrap metals, running errands and helping neighbors and friends—for pay. For some time they have been consumers, choosing the things they buy with allowances and earnings. They are helping their families spend larger sums for more significant and expensive items, too. They are observing and hearing adults discuss current problems such as taxes, commodity surpluses and shortages, international relations, foreign trade, unemployment, and prices. Radio, television and family discussions are stimulating their thinking. They are trying to understand these things; wanting to know "why" as well as "what." They are seeking to fit their experiences into meaningful patterns of understanding, trying to formulate satisfying patterns of comprehension to guide their choices and conduct.

In this learning process children need much help. Teachers often cannot give this help, for like most adults, teachers have not had the benefit of education that gives meaning to their economic environment. People generally, including teachers, don't understand the basic economics of the American way of life. They have difficulty acting wisely in their personal economic living. They do not understand the economic forces that motivate people and provide incentives, determine production, consumption, and prices, and make for scarcity or plenty of the goods and services we enjoy. Not understanding these factors, people are afraid of them. They indulge in wild and unsound pursuits of "security." They expect and demand in a thousand ways something for nothing. They vote for political schemes that promise advantages and benefits that cannot be delivered.

Economic ignorance indicates an unsatisfied human need, directly related to the economic and social welfare of all individuals. It is equally important for the union member, the white collar worker, the hourly employee, junior management and the senior executive to understand the inter-relationship of forces that operate in a free market and in our free society. To understand basic economics is to understand the American way of life. It is in the enlightened self interest of all components of our American society that economic facts be understood at an early age, and ingrained in the individual thinking process. The responsibility for vitalizing this phase of citizenship training resides with all the people. In discharging its responsibility, business management today is more and more addressing itself to the broad problem of encouraging economic education for people of all ages.

Since 1945 the management at General Mills has been working to stimulate industry-education cooperation in supplying this human need in children at the

4th, 5th and 6th grade levels. Here is the story of what has been done, twelve short steps in the long journey from economic ignorance to economic understanding.

Step 1: A survey was made to discover what, if any, basic economics children are learning in their classrooms at school. Findings showed that there is much basic economics implicit in subject matter studied in fourth, fifth, and six grade social studies but it is not made explicit in the learning process. The reasons are principally two-fold:

a. In their own educational experience, teachers have not had an opportunity to learn basic economics. Since they do not understand it, they do not recognize it in the materials they teach.

b. The materials used in elementary classrooms usually give no more than casual and incidental treatment to basic economic concepts. Economic concepts and ideas appear in unrelated and fragmentary form which is not conducive to good comprehension. Economic content receives no emphasis.

Step 2: Many people in all phases of education were interviewed to determine the desirability of giving more emphasis to basic economics in elementary school curricula. Teachers, curriculum experts, college professors, superintendents and educational specialists of all sorts expressed their views. A few opposed it. Many felt that more emphasis on basic economics was highly desirable. Others said it was necessary. Some said it was inevitable, and offered to help get things started to bring it about.

Step 3: An informal survey was made to see what could be done. The consensus seemed to be that a flour milling company might logically offer to educators the story of bread, with emphasis on the economics in that story.

Story of the Actual Program Offered

Step 4: With help from University of Minnesota staff members and school administrators and teachers in Austin and Duluth, Minnesota, nine panels of three pictures each were developed on stiff cardboards 12″ x 30″ in size. Each panel carried three pictures arranged in a vertical tier. The top picture depicted one process in the *Story of Bread* as it was produced in Ancient Egypt. The middle picture showed the same process in 19th century America. The bottom picture showed the same process in modern America. The nine cards, designed to stand side by side in the chalk board trays along the classroom walls, carried pictures appropriate to these captions: (1) The Story of Bread, (2) Preparing the Ground, (3) Planting, (4) Harvesting, (5) Threshing, (6) Marketing, (7) Storing, (8) Milling, (9) Baking.

A Teacher's Guide explained how the teached could use the panels to point out such significant developments in economic history as the increasing use of bigger, better and higher-powered tools and the resulting increase in the productivity of labor. The great progress during the past 100 years in America was contrasted with the negligible advances of the preceding thousands of years. Other concepts incidentally involved included individual freedom, property ownership, saving as the source of capital, specialization, and interdependence.

Further Help Sought From Top Educators

Step 5: Encouraged by the enthusiastic reception of this experimental unit, the company sought further advice and help from educators to develop other suitable materials. The idea evolved of using some of these panel pictures, adding others to them, and making a filmstrip. *Specialization* (division of labor), with its contribution to our vastly superior economic way of life in modern America, was the featured theme. A dialog to be read by one boy and one girl in the class as the filmstrip was shown gave emphasis to the economic content and served to stimulate class discussion. The same Teacher's Guide used with the *Story of Bread Panels* furnished teacher aid.

Step 6: Further consultation with educators led to development of a second filmstrip called *We Depend Upon Each Other*. This unit also used the dialog technique to emphasize economic content and stimulate class discussion. This unit developed the economic concept of interdependence within the family, the community, the nation and the world. The same Teacher's Guide offered aid to teachers using the filmstrip. The Des Moines, Iowa, school system furnished the principal educational cooperation on this unit.

Step 7: These panels and filmstrips were used experimentally in a limited number of middle-west schools. They brought spontaneous compliments and encouraging support from enthusiastic users. In January, 1951, the first real publicity of this whole effort was given at a demonstration in the Des Moines schools. Management representatives from 30 of America's leading companies met in Des Moines, heard the story of the industry-education effort and saw the filmstrip demonstrated in classrooms. The following April, these industry representatives met again in New York City to discuss ways to expand this effort to other companies and to other schools.

Step 8: To get more accurate and objective evidence of the impact of these units on children who worked with them, the company obtained the services of the Testing Bureau of the School of Education at the University of Minnesota to prepare equivalent before and after tests covering the subject matter dealt with in the units. These tests are now distributed with the units, which are sent out on request on a loan basis.

Step 9: When it became apparent that except for limited efforts here and there to tell a product story with some incidental economics in it, industry generally was not ready to take hold of this opportunity, General Mills went back to work to develop additional units, get further experience, and muster more persuasive arguments in favor of intensifying and expanding this sort of industry education work.

"Freedom of Choice" Is Top Booklet Subject

A poll taken in 1949 had indicated that teachers felt "Freedom of Choice" would be a top subject for another classroom unit. So, a "Freedom of Choice" unit was developed during the fall and winter of 1951. Its illustrated booklet format borrowed the color, charm and interest of the fabulously popular "comic book." This format was enhanced with beautiful art, bond paper, and academic qualities that made the resulting 24 page, 8½″ x 11″, four-color booklet a first class teaching piece—with none of the stigma "comic books" have in many educational circles. Using the stories of Robinson Crusoe, Swiss Family Robinson and a modern American fifth grader, the booklet showed how production and consumption are related and adjusted to each other through the choices of people. Special emphasis was given to the price system mechanism in America and to the values of freedom for producers and consumers to make their own choices and decisions.

A 16-page Teacher's Guidebook explained the purposes and objectives and presented a more complete picture of the economics to be taught. The Guidebook

also contained various ideas and activities for making the unit more interesting and informative. Des Moines, Duluth, Minneapolis, and Austin public school administrators and teachers, along with consultants in various colleges and universities, offered and approved ideas at all stages of development. Tests for measuring economic understandings of pupils before and after use of the unit were prepared with the assistance of the University of Minnesota Testing Bureau.

Distribution of the "Freedom of Choice" Sets

Sample sets of "Freedom of Choice" were distributed to businessmen, school administrators, teachers, and other interested people. Classroom sets were sent on request to nearly 3,000 teachers, who used the materials with more than 100,000 pupils. Each teacher using the unit with classes was asked to report back the results of the tests and to answer some subjective questions that would indicate the impact of the unit as she observed it. The unit was used in forty-seven states. Returns covering a good cross-section of more than 11,000 fifth and sixth grade pupils were tabulated and results were analyzed and evaluated during the 1952-53 school year.

On October 19, 1953 the results of this research were made public at a Minneapolis meeting of representatives from education and business. School people came from such institutions as the Universities of Chicago and Wisconsin, Cornell University, and Des Moines, Duluth, Austin, Rock Island (Ill.) and Minneapolis public schools. Business management was represented by men from such national companies as Eastman Kodak, Ford Motor Company, General Motors, U. S. Steel, and Monsanto Chemical Company, as well as from many local organizations.

As in Des Moines nearly three years earlier, these school and industry people visited elementary school classrooms to see economic education in action. They saw and heard "Freedom of Choice" discussed. They observed the educative process and learned what the research showed about the thousands of pupils who had studied the same materials in the preceding year. They learned that fourth, fifth and sixth graders and their teachers enjoy studying economics together. They learned that teacher, parent and child reaction to economic education of this kind was overwhelmingly favorable. They reviewed test results showing improvement in understandings of up to 200% on such matters as the importance of tools, why businesses fail, why we have freedom, and what happens when we fail to keep and exercise individual freedom of choice. They learned of General Mills' plans for continuing experimental work in this area of industry-education cooperation. They were again invited and urged to begin programs of their own in this field.

Step 10: During the summer of 1953, the company sponsored a six weeks basic economics workshop for elementary teachers and school administrators at the University of Chicago. This type of training has been very effective in presenting many different types of subject matter to teachers in service. Twenty seven public school teachers and principals from Illinois, Iowa and Minnesota came to Chicago to study basic economics and make plans and develop techniques for teaching what they learned to their classes. Chicago University staff and other educational specialists led the discussions and aided the workshoppers. All participants and staff members were inspired by the experience and are seeking to continue their efforts still further.

Role of General Mills In Actual Education

Step 11: Teacher training and school curriculum development are primarily the functions of well-established organizations in education. Likewise the preparation of teaching materials is the role of competent textbook publishing houses. General Mills has no desire or intention of usurping these functions, and believes that ultimately these organizations will wish to take the initiative in this work and use other industry in a supplemental or auxiliary role only. Consequently, individually and in groups, text and other school materials publishers are being urged by the company to develop materials in this area. School administrators, teachers, and teacher educators are being asked to give more emphasis to economic education of teachers and children alike. The company stands ready to encourage and aid experimentally in any way it can. This catalytic responsibility is large and challenging.

Step 12: The program of the company now has two specific goals in furtherance of its long range general objectives:

a. *Material development.* Three new units covering the subjects of competition, personal and property rights, and the balancing of unlimited wants with limited means are being published and distributed for experimental use during the current school year. These units use a problem-solving approach rather than the subject-matter approach used in the earlier units. Four-color, accordion fold, illustrated leaflets using "comic book" format, tell stories and pose economic problems common in the experiences of children, and raise questions for discussing and solving these problems. Brief illustrated commentaries on the back of these story leaflets and separately printed Teacher Guides suggest pertinent considerations. Before and after tests and subjective evaluation questionnaires to be returned by teachers are a part of these units and will be used to measure their effectiveness.

b. *Teacher Training and Curriculum Development.* Next summer at the University of Wisconsin and at the University of Chicago teacher training workshops similar to the 1953 summer program at Chicago will be held. Further training of teachers and more planning and organizing of materials for good integration into the curriculum will be the workshop objectives. The seven units provided by General Mills, along with other useful materials, will be organized into a teaching program that will be used by the workshop teachers in their classes in 1954-55. The "before" and "after" results of this program will be measured by appropriate tests. The same tests will be given to pupils in control classes using the same materials, but taught by teachers who have not had the benefit of workshop experience. They will also be given to pupils in control classes that are taught only the regular course of study by teachers who have had no workshop experience and who do not use the program materials. This experimentation is expected to furnish further and more conclusive data with which to fix the rate and course of further developments in the program.

An old Chinese proverb says that the longest journey starts with a single step. The journey toward an economically informed citizenry in America is just beginning. The steps are still short and the distances traveled small. But there are surer footings and better guideposts now than ever before. END

(Editor's Note: Mr. Burger's article is presented in this issue in lieu of the Economics Review regularly written by Robert H. Laws, Director of Economics Programs, SAM.)

CIPM Reports . . .

Lillian Gilbreth Wins International Award

Lillian Moller Gilbreth would be well-known today even if she were not distinguished in her own right as a consulting management engineer, author, and teacher. As the wife of the late Frank Gilbreth, a pioneer in scientific management, and the mother of twelve in *Cheaper By The Dozen*, Mrs. Gilbreth would be assured of posterity's remembrance.

But when management leaders of twenty-two nations of the world make Dr. Gilbreth their choice as the recipient of the Gold Medal of the International Committee of Scientific Management (CIOS), it reminds us sharply that this woman is being honored by an international group of hard-headed businessmen solely on her own performance and talents in making "fundamental contributions to the general body of management thinking." The award is an ungrudging and sincere recognition of great personal and professional accomplishment in the international field of management.

The Gold Medal was awarded this past February at the Tenth International Management Congress in Sao Paulo, Brazil, to a woman who has few peers in the hall of management fame. Lillian M. Gilbreth is certainly the "First Lady of Management," and no personage living or dead (save, perhaps, Frederick Winslow Taylor, whose protrait embosses the CIOS Gold Medal) is more widely known and revered among the international management fraternity. Her name is a rallying point for international tribute and management authority. Her honors in this country are matched by scores of foreign recognitions of her work, and her recent round-the-world trip to the Philippines, Australia, India, England, Brazil, and other countries was marked by an acclaim usually reserved only for visiting statesmen.

Lillian Gilbreth's career has combined a prolific output of children, books, teaching, and consulting. A graduate of the University of California, she received her Ph.D. from Brown in 1915 and has received subsequent honorary degrees from the University of Michigan, Rutgers, Russell Sage, Smith, and Princeton—to name a few. Married to Frank Gilbreth in 1904, she reared twelve children in a household which was the subject of two successful motion pictures, and is already part of familiar Americana. After her husband's death in 1924, she continued his pioneer work in Time and Motion Study and extended its scope to include such fields as home economics and agriculture. She thus became one of the nation's first consulting management engineers, and the first woman ever to practice this profession. She was Professor of Management at Purdue University from 1935 to 1948, served as chairman of the Department of Personnel Relations at Newark College of Engineering, and has applied her talents to the training of disabled war veterans since 1948. Today she is the President of Gilbreth, Inc., of Montclair, New Jersey.

Holds Membership in SAM

Dr. Gilbreth, who is an honorary member of SAM and a past Director of CIPM, has honored the membership rolls of such organizations as the American Management Association, The American Society of Mechanical Engineers, the American Association of University Women, and many others.

Her literary achievements are equally manifold. In addition to numerous papers on education, management, and psychology, Mrs. Gilbreth has also written eight books, including *Psychology for Management* (1912), *Time Study, Fatigue Study* (with her late husband), *Applied Motion Study, The Homemaker And Her Job,* and *The Foreman and Manpower Management* (1947).

Dr. Gilbreth's interest in scientific management at the international level began many years ago when she accompanied her husband on some of his foreign consulting assignments. Accustomed to the usual personality conflicts which arise in any large family, she was quick to notice that a general uniformity of human problems in industrial management existed across national frontiers.

Her success in spreading an understanding of scientific management abroad can be explained in large part by a broadly humane and patient nature. The term "Scientific Management" loses some of its cold, impersonal overtones when it is explained by Dr. Gilbreth as a tool for everyday living for *everyone*—industrial and office worker, homemaker, farmer—to make his lot happier, fuller, and more emancipated from inefficiency, drudgery, and fatigue.

Active in Past Conferences

The history of CIOS and its international congresses has a personal as well as professional significance for Dr. Gilbreth. Three days before she and her husband were to embark for Prague to attend the First International Management Congress in 1924, Frank Gilbreth died. Lillian Moller Gilbreth, with rare courage, took up his work and went to the Congress herself, to deliver the paper which he had worked so hard to prepare. From that significant occasion she has been known and acclaimed personally by the management leaders of many countries. Her influence has been felt immeasurably for over three decades by younger and older generations of management wherever she has made contact, directly or by reputation.

So there is poetic as well as professional justice in the action of the Tenth International Management Congress, thirty years later, when it conferred upon Dr. Gilbreth the highest accolade international management can offer. The only regret is that world management has no greater honors to award to a woman who continues to participate so energetically and effectively in a program bent upon making the benefits of enlightened management available to more and more people in the world.

No critic has commented on this amazing woman's singularity more aptly than did M. Rolf Nordling (using a mixed metaphor of mathematical probability and market analysis!) in pointing up her unique personality:

"There is perhaps one woman out of ten million who has twelve children. There are still fewer women who are brilliant management engineers. And if you want to calculate the probability of finding a woman who combines both these qualities, you have to multiply ten million by a hundred million, which makes a probability so near nought that we may wait ten thousand years before we find a new Mrs. Gilbreth!"

BY ROBERT GLEASON
DIRECTOR OF RESEARCH, CIPM

The COUNCIL FOR INTERNATIONAL PROGRESS IN MANAGEMENT, formerly the National Management Council, is a non-profit, non-political organization devoted to the promotion of the practice of scientific management on the international level. SAM is a co-founder and charter member of CIPM.

APRIL CHAPTER ACTIVITIES

CHAPTER	SUBJECT	SPEAKER	TITLE	PLACE	DATE
Atlanta	Student Chapter Meeting—Atlanta Div. of Univ. of Georgia, Emory Univ., Georgia Tech	Robert R. Gibson	Industrial Engineer, Cluett, Peabody & Co.	Atlanta Athletic Club	8
Baltimore	Aids in Making Decisions	C. Canby Balderston	Dean, Wharton School, Univ. of Pa.	Stafford Hotel	5
Binghamton	Management and the International Labor Organization	Senator Irving Ives	U. S. Senator	Arlington Hotel	17
Birmingham	Trends in Union Management Relations	Dr. Langston Hawley	Professor of Management, U. of Alabama	Molton Hotel	13
	Plant Visit			Avondale Mills	20
Boston	Work Simplification	Harold Dunlap	Work Simplification Director, H. P. Hood & Sons, Co.	University Club	1
Central Pa.	What Management Expects From Accounting	W. W. Sieg	President, Titan Metal Manufacturing Co.	State College, Pa.	22
Chicago	Industrial Engineering Seminar				13
	SAM Job Clinic			Northwestern Univ.	17
	Work Simplification: Yesterday, Today, and Tomorrow			Furniture Club of America, Furniture Mart	27
Cincinnati	What Motivates People in Work Situations	Dr. Carroll L. Shartle	Personnel Research Board, Ohio State University	Hotel Alms—Marie Antoinette Ballroom	1
Clearing	Maintenance of Plant Site	J. A. Hartwick		Clearing Ind. Club	8
	Harvard Case Study	J. M. Duffey		Bethlehem Steel Co.	14
	Luncheon Meeting			Clearing Ind. Club	15
	Foreman's Clinic	E. Matz		Bedford Park Community Center	22
	Harvard Case Study	J. M. Duffey		Bethlehem Steel Co.	28
Cleveland	Management Control Clinic				7
	Plant Tour			Ford Foundry and Engine Plant, Timken Roller Bearing Co.	
	Industrial Engineering Round Table	Nevin K. Brothers		Tomlinson Hall—Case Campus, Conference Rm. C	19
	Top Management Round Table	Hugh D. Luke		Tomlinson Hall—Case Campus, Conference Rm. C	21
	Industrial Relations Round Table	Edwin D. Phillips		Tomlinson Hall—Case Campus, Conference Rm. C	26
Columbus	Planning for an Executive Development Program	Neil Skinner	President, Hoffman Specialty Co.	Ft. Hayes Hotel	15
Dallas	Membership Luncheon—Guided Tour			Mercantile National Bank	14
Dayton	Product Development, A Basic Management Tool	Dr. Philip R. Marvin	V. P., Commonwealth Engineering Co.	Engineer's Club	27
Detroit	Time Study Leveling	Prof. David B. Porter	Industrial Management Engineering, New York Univ.	Rackham Educational Memorial	7
Fox Valley	Foremanship is a Profession	Vincent J. Linn	Area Manager, National Association of Foremen		8
Greensboro				Starmount Country Club	13
	Plant Visit			Cone Mills	29
Greenville	Materials Handling	Clem Sollenberger	Exec. V. P., Conveyor Equipment Manufacturers Assn.	Hotel Greenville	14
Hartford	Student Chapter Night—U. of Connecticut			Storrs, Conn.	15
Hudson Valley	The Financial Department's Function in an Organization	D. C. Dougherty	Director of Organizational Planning, American Hard Rubber Company	Hendrick Hudson Hotel, Troy, N. Y.	6
Indianapolis	Spring Forum				14
Kansas City	Industrial Office Procedure and Equipment Exposition			Pine Room, Fred Harvey Restaurant, Union Depot	20
Knoxville	Work Measurement of Clerical Activities	Paul B. Mulligan	Paul B. Mulligan & Company	Farragut Hotel	8
Lancaster	Institute of Management (SAM, NACA, and Franklin and Marshall College)			Franklin and Marshall College	9
	Creating Opportunities Within the Organization	Dr. Ernest Dale	Graduate School of Business, Columbia University	Hotel Brunswick	20

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Lehigh Valley	The Role of Arbitration in Labor-Management Relations	Attorney H. P. McFadden			13
Madison	Human Relations Today	Kirkpatrick	U. of Wisconsin		7
Manchester	Wife As Partner in Business—Ladies' Night	Mrs. Wallace Clark	Wallace Clark Marketing Center, New York Univ.	Carpenter Hotel	7
Milwaukee	Progress in Materials Handling	AMHS—Elks Club		E.S.M. Building, 3112 W. Highland Ave.	8
Montreal	Management Reduces Overhead Through Paper Work Simplification	Ben. S. Graham	Director, Future Demands Dept., Standard Register Co.	Ritz-Carlton Hotel	14
Nashville	Measurement of Clerical Activities	Paul B. Mulligan	Paul B. Mulligan and Associates	Andrew Jackson Hotel	7
	Work Simplification Techniques				12-23
New Haven	Industry's Acceptance of Predetermined Time Systems	John L. Schwab	John L. Schwab and Associates	South Meriden House, Meriden	22
New York	Management Men for Tomorrow—Careers Round Table	Bernard Haldane		Roosevelt Hotel	15
Northern New Jersey	Organizing for Cost Reduction	Bruce Payne	Bruce Payne & Associates	Essex House	22
Philadelphia	Plant Tour	A. F. de Long		Budd Hunting Park Plant	1
	Management Development (Student Chapter Night)	Elles M. Derby	Manager, Management Education, Metropolitan Life Ins. Co.	Poor Richard Club, 1319 Locust Street	6
	Budgets	H. A. Rotondi		Atlantic Refining Co., 260 S. Broad Street	14
Pittsburgh	Automation—A New Management Challenge	John Diebold	Consultant	Webster Hall Hotel	22
Portland	Managerial Development	Don Osborne	Crown Zellerbach	Pacific Power & Light Board Rm., Public Service Bldg.	21
Providence	Statistics—How to Present Them to Management	Dr. Ellis D. Ott			1
Raritan Valley	Work Measurement and Wage Incentives for Industrial Maintenance Trades	Stewart Whitehead	Calco Chemical Div., American Cyanamid Co.	Roger Smith Hotel, New Brunswick, N. J.	21
		E. L. Conrad	Chief Ind. Engineer, Lowe Paper Co.		
		W. H. Fanning	V. P., Albert Ramond & Associates		
Reading	Incentives—Round Table Discussion			Iris Club, Wyomissing, Pa.	12
Richmond	Production Methods and Measurements	Robert Levin	United Mills Corp.	John Marshall Hotel	27
Sacramento	Plant Visit				6
St. Louis	Development of Effective Channels of Communication				12
Trenton	Operations Research—New Tool of Scientific Management	Kenneth W. Yarnold	Director of Operations Research, Dunlap & Associates, Inc.		20
Twin City	Industrial Relations Conference Speakers Dinner				5
	12th Annual Industrial Relations Conference				6 & 7
Western Mass.	Materials Handling and Communications Control	James Bright	National Handling Commission	Ivy House, W. Springfield	15
Western N. C.	Oerlikon Tool and Arms Works	Lt. Gen. K. B. Wolfe, Retired	President, Oerlikon Tool and Arms Corp. of America	Oerlikon Tool and Arms Corporation, Asheville	15
Wilmington	Materials Handling at RCA-Victor Division	Norman Shikes	Manager, Materials Handling, Victor Div., RCA	Hob Nob Tea Room	8
Worcester	A Program for Executive Development	Abram T. Collier	V. P., Personnel, John Hancock Mutual Life Ins. Co.	Hickory House	12

New Management Writing . . .

PUBLIC ADMINISTRATION, *by Marshall Edward Dimock and Gladys Ogden Dimock. Rinehart & Company, Inc., New York. 531 pages. $5.00.*

A reading of the table of contents of this book will quickly indicate to the informed reader its distinctive orientation as compared with other texts in the field. From this reviewer's point of view, it is a superior and preferred orientation. For it combines content on descriptive, structural data with an operational point of view, a sense of administrative realism and a mindfulness of the motives of men in the governing and direction of men. It thus conveys a sense of dynamism and of the impact of throbbing human interrelations which any adequate study of this field surely requires. The senior author has had the inestimable advantage of having joined in actual federal administrative labors in ways made more explicit in his earlier and useful volume, *The Executive in Action.* (Harper & Brothers, 1945). The resulting product here is admirable in its humanistic quality.

Had your reviewer the occasion to teach a college course in this field or work with adults in such a body as the League of Women Voters, this would certainly seem to me to be an informing and persuasive text to share with those willing to see public administration in its inwardness as human experience and interplay in the environment of public bodies at work. —ORDWAY TEAD

AMERICAN INCOME AND ITS USE, *by Hoyt, Reid, McConnell, Hooks, and Muelder. 362 pages. Harper & Bros. New York. $4.00.*

The fourth volume of the "Series on the Ethics and Economics of Society." It focuses on the dramatic rise of American income in the past two generations, pointing out that abundance necessitates a re-examination of ethical concepts. Part of a series initiated by the Federal Council of Churches, under a committee headed by Charles P. Taft.

PATTERNS OF INDUSTRIAL BUREAUCRACY, *by Alvin W. Gouldner. 282 pages. The Free Press. Glencoe, Illinois. $4.50.*

The author is Associate Professor of Sociology at Antioch College. He describes how outside ownership, taking over a gypsum plant, creates a "succession crisis," and forms some interesting generalizations. Written with sympathetic understanding and very little of the "academic" tone, though carefully done.

SALES KNOW-HOW, *by Robert A. Gopel. 61 pages, Printers' Ink, New York. $2.00.*

The Director of Sales Training of the Koppers Company offers a distillation of his experience and that of his associates on that perennial question, salesmanship. An important book on an important subject by an unquestionable authority.

THE ECONOMIC ALMANAC, *1953-1954. The National Industrial Conference Board. 752 pages. Thomas Y. Crowell Co. New York. $3.95.*

A handbook of useful facts about business, labor and government in the United States and other areas, offered to the public for the first time by the NICB, which has been furnishing this information to its membership for many years. An invaluable reference text.

IMPROVING SUPERVISORY BEHAVIOR, *by Eugene E. Jennings. 35 page pamphlet. University of Wisconsin, Madison. $1.15.*

The author, now assistant professor at Wharton School, discusses the nature and improvement of one of management's prime-importance resources, the foreman. Neglect of this strangely "in-between" position can have telling, overall effect on both morale and productivity.

GROUP DYNAMICS, *by Dorwin Cartwright and Alvin Zander. Row, Peterson and Company. $6.00.*

A great deal has been written in recent years on the behavior of groups. Some of it has found its way into the management literature and has been recognized as a fruitful area to be explored for advancing management theory and practice.

While most of the earlier efforts were by way of speculative thinking, the past two decades have seen a good deal of careful, systematic research. The transition from exploratory studies to objective quantitative observation, measurement and "controlled" experimentation came only gradually. The research Center for Group Dynamics at the University of Michigan, with which the authors are associated, has always played a predominant role in this work, one of the most vital in management research.

While *Group Dynamics* is not oriented toward management in particular, its implications in regard to problems of motivation, leadership, productivity and organization cannot escape even those uninitiated into the mysteries of social science. Some of the research presented is taken from the industrial environment and is directly applicable, however.

The authors have accomplished their task by selecting some of the outstanding articles describing research and its methodology in the field of group behavior, and by presenting them in six parts:

1. Approaches to the Study of Groups
2. Group Cohesiveness
3. Group Pressures and Group Standards
4. Group Goals and Group Locomotion
5. The Structural Properties of Groups
6. Leadership

Each of these six parts is preceded by a chapter which summarizes and interprets the results of various investigations in the particular area. The authors stress that these integrations are necessarily premature, since current research still leaves us with many gaps and inconsistencies, and that the conclusions reached are tentative at best. Nevertheless, a reading of these six summaries affords a good view of the present state of knowledge.

In reading some of the specific research projects, one cannot help but be impressed by the skill, effectiveness, and imagination with which the scientific method is applied to problems of human behavior. Therefore it is good to note the increasing support research of this type is receiving from such institutions as the Rockefeller and Ford Foundations, the Office of Naval Research, and from many individual concerns. Without the consent and active cooperation of the "laboratory" organizations, progress would not be possible. Mr. Cartwright and Zander have made a valuable contribution toward group dynamics.

—WALTER B. SCHAFFIR

PRODUCTIVITY AND PROBABILITY, *by Thomas F. O'Connor. 193 pages. Emmott & Co. Manchester, England.*

A competent treatise on time study and the improvement of industrial efficiency, by an engineer of twenty years standing who turned his attention to a new field. A smooth treatment of a prickly, technical subject.

PUTTING YOUR MONEY TO WORK: *The Story of Stocks and Bonds, prepared by Merrill, Lynch, Pierce, Fenner and Beane. 21 pages.*

This informative booklet was prepared by America's best known investment brokerage house for use in acquainting company employees in the nature of business securities. A reasonable introduction to investment financing; readable, clear. Might well be on any company booklet rack.

AN INTRODUCTION TO TRADE UNIONISM, *by G. D. H. Cole. 324 pages. George Allen & Unwin, Ltd. London. $4.25.*

A study of British Trade Unionism, with comparisons to other economies. The author, an Oxford professor, has rewritten the book completely for the third time since 1918, to keep abreast of changing conditions.

DESIGN FOR DECISION, *by Irwin D. J. Bross. 276 pages. The MacMillan Company. New York. $4.25.*

Design for Decision is a book with a message; a message for all management men who make decisions to use statistical methods rather than arrive at decisions by some preconceived or instinctive reasoning.

The book is light, arm-chair reading, packed with illustrations. The work first develops enough basic material for the reader to understand prediction and probability. From this point the author outlines some "rules for action" to follow. The establishment of a "decision maker," collection of data, and making the model are presented with graphic illustrations.

Mr. Bross has succeeded in arousing the curiosity and interest of the reader in each chapter, so that he will want to pursue the subject further. With this in view, the author gives sufficient references for further reading. A good example of this is the chapter on value. More than one man has devoted his entire life to the subject of value and, after a lifetime study, felt that he has only scratched the surface. The author in seventeen pages discusses value so that the reader gets an introduction to this important subject.

Design for Decision treats a very technical subject in a non-technical manner, so that the reader can begin to think in terms of probabilities and of quantitative rather than qualitative terms. The author's own words best show the book's underlying idea:

"A large proportion of the controversies in science, and in everyday life, turn out to be basically verbal problems, and a symbolic translation following the pragmatic principle is often a good way to clear away the verbal underbrush and expose the path to decision. In this way, we can avoid distracting verbal will-o'-the-wisps and concentrate on the essentials of the problem, the probabilities and desirabilities. I have found the concepts of Statistical Decision useful in this respect in the course of my consultations. You might try them."

—FRED H. LAMBROU

GUIDE TO PENSION AND PROFIT SHARING PLANS, *by Robert S. Holzman, Ph.D. 64 pages. Farnsworth. Mount Vernon.*

Answers to the major basic questions in this area. Done in concise question-and-answer form. Written by a Professor of Taxation at New York University and Past President of the Federal Tax Forum. A valuable book for those businessmen whose responsibility includes working out a plan to cover this important, growing business and industrial factor.

OCCUPATIONAL DISEASE REPORTING, *by Victoria M. Trasko. 80 pages. U. S. Department of Health, Education and Welfare. 40 cents.*

A review of current practices, together with a collection of incidence statistics. Important because the health and occupational disease statistics are intimately concerned with the pension planning of any industry or business, not to mention the over-all picture of actual day-to-day productivity.

MANAGEMENT FACES NEW PROBLEMS. *Proceedings of the 1953 Fall Management Conference sponsored by the Society for Adancement of Management. 178 pages. $5.00. ($3.50 for SAM members.)*

Eighteen management and technical men discuss the industrial future in terms of such approaches as Operations Research, Communications, Organization, and Executive Development. The first hard-cover Proceedings book SAM has published, with an especially able group of authors.

Ad Review . . .

Who Are The Buyers?

Usually two individuals issue the order for advertising that is released for publication in business papers: the advertising manager in the plant, and the account executive in the advertising agency.

Before these two "buyers" make a final decision to use ADVANCED MANAGEMENT, or any of the other 2,000 business papers now published in this country, a careful study is made of the magazines.

ADVANCED MANAGEMENT, with an average of three readers per copy, offers any advertiser a highly selective group of buyers' of materials and supplies.

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Few of the members of SAM carry the title of Advertising or Sales Manager, but practically all of them are tremendously interested in advertising that offers goods or services that may aid in cutting costs and increasing net profits.

The Purchasing Agent makes out the final orders, *but*, back of him are one or a dozen other men who carefully analyze any product or service that might be bought.

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Advertisers and advertising agencies are invited to use SAM's advertising and research department. No charge is made.

—FRANK E. FEHLMAN

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